Notice of Construction Application for Landfill Gas to Pipeline Gas Treatment Facility

Prepared for

Bio-Energy, LLC

Submitted to:

Puget Sound Clean Air Agency

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Prepared by

CH2MHILL

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Acronyms and Abbreviations

ACA	Air Compliance Advisor
ASIL	acceptable source impact level
BACT	best available control technology
BPIP	Building Profile Input Program
Btu	British thermal unit(s)
C	Celsius
CAPCOA	California Air Pollution Control Officers Association
CARB	California Air Resources Board
CATC	Clean Air Technology Center
CHRL	Cedar Hills Regional Landfill
CI	compression ignition
CO	carbon monoxide
CO_2	carbon dioxide
CFR	Code of Federal Regulations
°	degrees
DE	destruction efficiency
DEM	Digital Elevation Model
DPF	diesel particulate filter
Ecology	Washington State Department of Ecology
F	Fahrenheit
GHG	greenhouse gas
$H_2O(g)$	water vapor
HAP	hazardous air pollutant
hp	horsepower
ICE	internal combustion engine
KCSWD	King County Solid Waste Division
kW	kilowatts
lb	pound(s)
MACT	Maximum Achievable Control Technology
Mcf	million cubic feet
MW	megawatts
NAAQS	National Ambient Air Quality Standard
NAD	North American Datum
NCDC	National Climatic Data Center
NESHAP	National Emission Standards for Hazardous Air Pollutant
NMOCnon-methane organic carbon	
N_2	nitrogen
NO	nitric oxide
NO_2	nitrogen dioxide

NOx	nitrogen oxide
NSR	New Source Review
PM	particulate matter
ppbvd	parts per billion volume, dry
ppm	parts per million
PSCAA	Puget Sound Clean Air Agency
PSD	Prevention of Significant Deterioration
RICE	Reciprocating Internal Combustion Engines
scf	standard cubic foot
SCR	Selective Catalytic Reduction
SEPA	State Environmental Policy Act
SO_2	sulfur dioxide
SOF	soluble organic fraction
SQER	small quantity emission rate
TAP	toxic air pollutant
tpy	tons per year
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
UTM	universal transverse Mercator
VOC	volatile organic compound
WAC	Washington Administrative Code
WWTP	waste water treatment plant

1. Process Description

Bio Energy (Washington), LLC, proposes to construct and operate a facility to process landfill gas generated by the Cedar Hills Regional Landfill (CHRL) into methane suitable for distribution by Northwest Pipeline to its customers. The facility will consist of landfill gas processing equipment, an electrical generating facility, a thermal oxidizer and an "emergency flare." The CHRL produces about 11,000 cubic feet per minute of landfill gas, which typically contains about 46 percent methane, 40 percent carbon dioxide, 10 percent nitrogen, two percent oxygen and other materials. The gas processing system will remove hydrogen sulfide, nitrogen, water, carbon dioxide, non-methane organic carbons (NMOCs), and oxygen from the landfill gas stream to produce about 4,000 cubic feet per minute of a stream containing about 97 percent methane and 3 percent nitrogen for injection in the pipeline. The process will also generate a stream containing about 40 percent methane, 6 percent carbon dioxide and 54 percent nitrogen that will be used to power an electrical generating facility of up to 12 generators. A waste gas stream containing NMOCs, methane and carbon dioxide will be sent to a thermal oxidizer. Sulfur containing gases are removed from the landfill gas using a sulfur scavenger system, which takes the sulfur from the landfill gas and turns it into iron sulfide.

The facility will have a second "emergency" flare to handle gas streams during startup and shut down, periods the engines cannot accept landfill gas, and other "emergency" situations. When the Bio Energy facility cannot operate the landfill gas produced by CHRL will be directed to CHRL's existing flares. The emergency flare is expected to operate less than 500 hours per year. A diagram of the gas processing facility is shown in Figure 1.

The proposed project will have two significant emissions sources. The electrical generating facility will produce emissions of nitrogen oxides, carbon monoxide, formaldehyde, particulate matter, and other air pollutants. The facility will consist of 12 Detroit Diesel Series 60 engines modified by Bio Energy to operate on methane from the process and a pilot charge of diesel fuel. Each engine will power a 350 kW generator. Electricity generated will be used the gas processing facility and will be supplemented by electricity from the grid. The facility will require about six megawatts (MW) of power to operate at full capacity. Bio Energy will produce about three MW of power from the operation of generators deriving about 92 percent of the energy required for operation from the landfill gas processing facility. The remainder fuel for the generators will be supplied by diesel fuel. The power generating facility has the ability to generate up to four MW of power and may do so for short periods. The facility is designed for redundancy. That is, the standard operation of the facility will be electricity produced from six to ten engines with the remaining engines in place as backup. The facility can operate on 100 percent diesel fuel and can operate up to 12 engines. Primarily, the engines will operate in the dual-fuel mode and the number of engines operating will depend on the quantity of methane sent to the engines from the landfill gas processing system. However, except for engine startup and shut down, which are done on 100 percent diesel fuel, it is expect that the electrical generating facility will operate in the dual-fuel mode as described above. In no case should any engine operate on 100 percent diesel fuel for more than 500 hours per year, excluding startup and shut down.

The thermal oxidizer is designed to destroy methane and NMOCs in a waste gas stream that are byproducts of the gas processing facility. The thermal oxidizer is expected to operate continuously and will produce the only other significant emissions from the facility. The facility will also include a 10,000-gallon storage tank for diesel fuel and an oil water separator. A process flow schematic of the facility is provided in Figure 1.

Expected Environmental Benefits

The project will result in an overall reduction of emissions, including Greenhouse Gas (GHG) emissions. Currently, the methane generated by the landfill is combusted in flares and turned into carbon dioxide, with no heat or energy recovery. The methane stream sold to Northwest Pipeline will also eventually be combusted; however the energy from the methane will be recovered as either heat or work. The project results in a reduction of GHG emissions because the methane stream from the landfill will displace an equal amount of methane, or natural gas, in the pipeline. The result is that a thermal quantity of natural gas from the pipeline equal to the thermal quantity of methane inserted to the pipeline from the landfill is no longer needed to produce energy, and therefore not combusted.

Carbon Dioxide Footprint Reduction

The Bio Energy facility will capture methane currently being flared by the landfill and send a majority of the methane to a gas pipeline for commercial use. We estimate that this will reduce the carbon foot print of the landfill by 63 percent.

TABLE 1
Greenhouse Gas Balance
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Greenhouse Gas	Amount	Units
Landfill Gas	5,780	mmcf/yr
CO_2 From Natural Processes	42,037	tpy
CO_2 From Flaring Methane	165,146	tpy
Total CO_2	207,183	tpy
Cedar Hills Project		
CO_2 From Natural Processes	42,037	tpy
CO_2 From Electricity Production	18,352	tpy
CO_2 from Thermal Oxidizer	16,765	tpy
CO_2 Project total	77,154	tpy
CO_2 Reduction from Project	62.8percent	

mmcf = million cubic feet
tpy = tons per year

Nitrogen Oxide Emissions Reduction

In 1999 CHRL produced 68 tons of nitrogen oxide (NOx) from flaring the landfill gas. Base on an estimate that the landfill produces 11,000 cubic feet per minute of landfill gas that is sent to the flares, the NOx will increase to as much as 93 tons per year (tpy). Preliminary estimate of NOx emissions from the Bio Energy facility is about 42 tpy from the engine operation and thermal oxidizer. This results in an estimated reduction in NOx emissions of 25-50 tons per year from the landfill location.

Sulfur Dioxide Emissions Reductions

The process removes sulfur in the form of hydrogen sulfide and mercaptans from the landfill gas. Landfill gas consumed by the facility will have low sulfur content. Based on our assumptions of landfill gas sulfur content, we will remove about 6.9 pounds per hour of sulfur from the gas. This results in a net sulfur dioxide (SO_2) decrease of up to 60 tpy.

FIGURE 1
Cedar Hills Landfill Gas Reclamation Process Schematic
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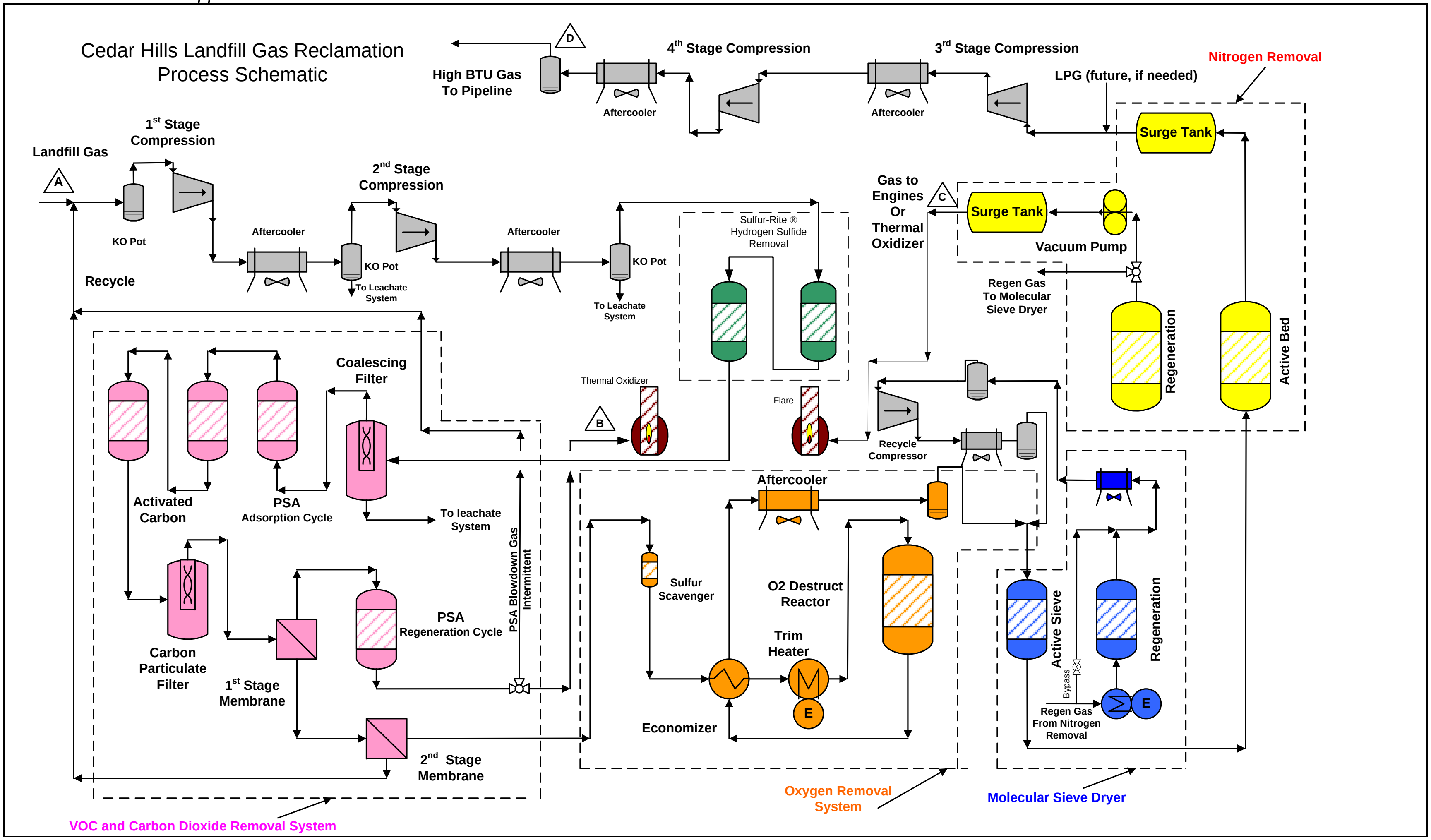

2. Applicable Emission Limit Regulations

Engines

The engines are subject to the Puget Sound Clean Air Agency's (PSCAA's) general emission limits of 20 percent opacity and 0.05 grains per standard cubic foot as contained in PSCAA Regulation I, Article 9. The Washington Administrative Code (WAC) 173-400-040 contains similar requirements. The United States Environmental Protection Agency (USEPA) has adopted several standards for internal combustion engines. Two of the New Source Performance Standards apply to stationary internal combustion engines; they are 40 Code of Federal Regulations (CFR) 60 Subpart JJJJ and Subpart IIII; subpart JJJJ applies to new stationary spark ignition engines. Subpart IIII (Performance for Stationary Compression Ignition Internal Combustion Engines) applies to compression ignition (diesel) engines at facilities that commenced construction after July 11, 2005 and 2007 (model year) and later diesel engines. The engines being proposed by Bio Energy are compression ignition, hence Subpart IIII would apply. Those standards are shown in Table 2.

TABLE 2
Applicable Subpart IIII Emission Standards engines manufactured 2007-2010
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Pollutant	g/kW-hr	Proposed g/kW-hr
NMHC + NOx	4.0	2.7
Carbon Monoxide	3.5	1.7
Particulate Matter	0.20	0.08

g = grams?
kW-hr = kilowatt-hour

Subpart IIII also requires compliance with 40 CFR 89 113 Smoke emission standard. That regulation requires the following:

(a) Exhaust opacity from compression-ignition nonroad engines for which this subpart is applicable must not exceed:

(1) 20 percent during the acceleration mode;

(2) 15 percent during the lugging mode; and

(3) 50 percent during the peaks in either the acceleration or lugging modes.

(b) Opacity levels are to be measured and calculated as set forth in 40 CFR 86, subpart I.

40 CFR 60.4207 also requires that diesel fuel used be low sulfur fuel. USEPA has adopted National Emission Standards for Hazardous Air Pollutant (NESHAP) for Reciprocating

Internal Combustion Engines (RICE) in 40 CFR 63 Subpart ZZZZ (National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines). Under a January 18, 2008 amendment, these standards apply to both facilities that emit more than 10 tons per year of any hazardous air pollutant (HAP) or more than 25 tons per year of all HAPs combined and to the sources that have lower emissions. The proposed facility will emit less than 10 tons per year of any HAP and less than 25 tons per year of all HAPs combine; hence it will be classified as an area source for HAPs. 40 CFR 63.6590(b) identifies Stationary RICE subject to limited requirements to include a "stationary RICE with a site rating of less than or equal to 500 brake hp which combusts landfill or digester gas equivalent to 10 percent or more of the gross heat input on an annual basis," and "a CI stationary RICE with a site rating of less than or equal to 500 brake hp." The proposed engines will meet both of these requirements. For such engines Subpart ZZZZ only requires that they "must meet the requirements of this part by meeting the requirements of 40 CFR 60 subpart IIII… . No further requirements apply for such engines under this part."

Flare and Thermal Oxidizer

Flares must meet the same general emission limits of opacity and particulate matter (PM) under PSCAA and state regulations as the engines. In addition the flares must comply with the USEPA emission standards contained in 40 CFR 60.18 General control device requirements. These requirements require flares to have no visible emissions, except for 5 minutes in a 2 hour period, comply with specific exit velocity requirements, and comply with specific fuel requirements. The proposed flare complies with these requirements.

Diesel Storage Tank and Oil Water Separator

The facility will also include a 10,000 gallon storage tank for diesel fuel and oil/water separator. Both units are considered exempt based on the Puget Sound Clean Air Regulation 1, 6.03 (c), 78E and 90.

3. Applicable New Source Review Regulations

Puget Sound Clean Air Agency

The Puget Sound Clean Air Agency (PSCAA) Regulation I, Article 6 adopts most of the substantive requirement of the Washington State Department of Ecology's (Ecology) New Source Review program contained in Chapter 173-400 WAC.

State

Under Ecology's New Source Review (NSR) rule, WAC 173-400-110, a source is subject to state Prevention of Significant Deterioration (PSD) review, minor NSR, or both. The proposed project meets the definition of new source contained in WAC 173-400-030(52) and therefore must comply with WAC 173-400-110. Ecology has adopted the current federal PSD program into Chapter 173-400 WAC.

Federal

The proposed facility would be subject to PSD review if it were a major stationary source as defined in 40 CFR 52.21(b)(2). That section defines a major stationary source as one that has the potential to emit 250 ton per year of any regulated NSR pollutant or 100 tons per year if the source is in one of 27 listed categories. As discussed below in Chapter 4, the proposed facility will emit less than 100 tons per year of any regulated NSR pollutant; therefore, the proposed facility will not be subject to PSD review.

4. SEPA

A State Environmental Policy Act (SEPA) checklist has been submitted to King County Solid Waste Division (KCSWD). The checklist has been deemed complete by KCSWD and is currently under review.

5. Emission Estimates

There are two significant emission sources for the facility, a waste gas thermal oxidizer and 12 Detroit diesel engines. The thermal oxidizer emissions of NOx and carbon monoxide (CO) are based on the vendor guaranteed emission limits of 0.06 pounds (lbs) NO_x/million British thermal units (MMBtu) and 0.3 lbs CO/MMBtu. PM emission emissions are from AP-42, Fifth Edition, Volume 1, Section 2.4. The process is equipped with a landfill gas sulfur removal system which is designed to remove 99.9 percent of the sulfur from the landfill gas, so sulfur dioxide emission are expected to be essentially zero, with about seven parts per million (ppm) of sulfur remaining in the landfill gas waste gas stream going to the flare. Non-methane organic carbon (NMOC) and toxic air pollutant (TAP) emissions are based on laboratory analysis of landfill gas samples and assume 98 percent destruction efficiency (DE) in the flare.

The engines can operate at any gas fraction. However, the engines do not typically operate at gas fractions greater than 40 percent or less than 81 percent. This range requires a reduction in engine output because of the potential for engine knocking, which would destroy the engines. Although the engines can operate in the dual fuel mode with 30-40 percent of the required energy derived from methane, this is not the preferred mode for both economic and emissions reasons. Standard operation is the engines operating on 100 percent oil for startup and a few periods that methane is not available. The majority of the time, the facility will operate above 88 percent gas fraction.

Operations on 100 percent oil will happen when an engine is started up and shut down. The engines are started on 100 percent oil, idled between zero to 50 kW output to come to operating temperature and then the output is increased to about 200 kW and methane is started to go to the final, set gas fraction. On shutdown, the gas is turned off and the engine is idled until the engine temperature decreases to an acceptable range. Startup and shut down generally take about 5 minutes and almost never take more than 15 minutes.

Gas fractions reported at ranges greater than 40 percent and less than 81 percent are the result of recordings captured during transitions between low and high gas fraction and are usually the result of startup and shutdown operations.

The standard operation of the facility will be for six to ten engines to be running with the remaining engines in place as backup. However, and any time the facility may operate on more or less than six engines. Except for engine startup and shut down, which are done on 100 percent diesel fuel, it is expect that the electrical generating facility will operate in the dual-fuel mode which will typically be at 92 percent landfill gas and 8 percent diesel fuel. The emission estimates were calculated assuming that 10 engines can operate on 92 percent landfill gas 8,260 hours per year. To be conservative, the emissions also include an assumption that the generators may have to run on 100 percent low sulfur diesel fuel for maximum of 500 hours per year.

The emission factors for the generators are a compellation of numerous source test conducted on the generators. Emission rates from the Detroit Diesel Series 60 engines follow predictable relationships between gas fraction and emissions rates. The general relationship between NOx, CO, and gas fraction are shown in Figure 2 below, from source testing at a similarly designed INGENCO facility with no emission controls.

FIGURE 2
Wicomico Stack Testing
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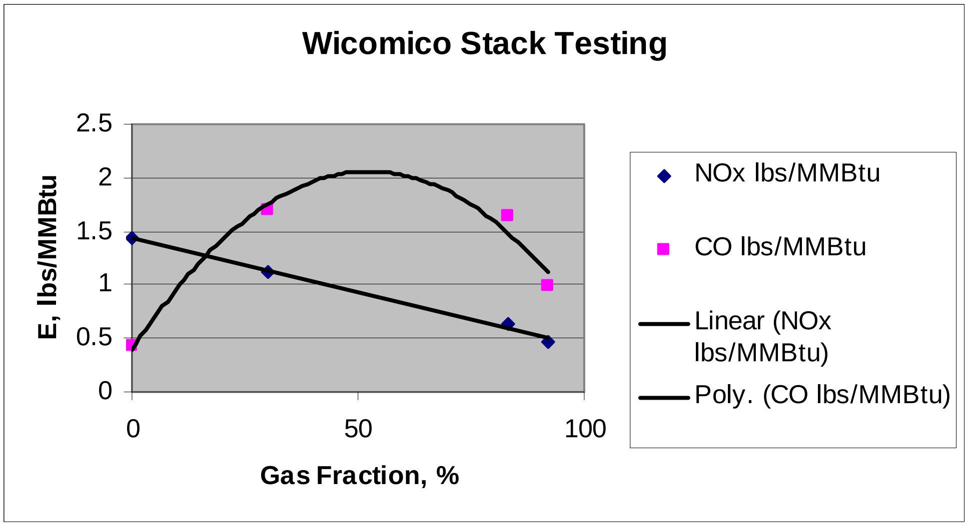

NOx decreases predictably between zero percent gas fraction (100 percent oil) and 96 percent gas fraction. The slope above is linear with a high r^2 value. However, the predicted slope follows a third order equation. CO increases to about 65 percent and then decreases (second order equation). The relationships between zero to 30 percent and 81 to 96 percent are essentially linear. These linear relationships allow emissions to be calculated using the following relationships:

$HI_{total} = HI_{LFG} + HI_{Liq}$
$E_{parameter}$ (lbs) $= HI_{Liq} \text{ X } F_{parameter,\ liq} + HI_{parameter,\ LFG}$

Where, HI = heat input in MMBtu and $F_{parameter}$ is the site-specific emissions factor for NOx or CO for landfill gas (methane) or liquid fuel.

This information is also contained in the “Equations” tab of the emissions spreadsheet. Emissions are calculated by knowing the volume of fuel and the heat content of that fuel in three ranges of gas fraction: zero to 40 percent, greater than 40 percent to less than 81 percent, and greater than 81 percent.

Emissions rates in lbs/MMBtu and emissions factors in lbs/MMBtu are valid if one knows the gas fraction range and do not require specific gas fractions. That is, if half the engines operated at zero percent gas fractions and the other half operated at 30 percent, the emissions would be the same if the engines operated at 15 percent gas fraction.

The estimated potential emissions assume the use of an oxidative catalyst with a vendor designed removal rate of 95 percent to 99 percent for CO and formaldehyde. The oxidative catalyst will also remove other hydrocarbons at approximately the same rate of 95 percent to 99 percent, however a 90 percent removal rate was assumed for the calculations. The oxidative catalyst will also remove 20 to 50 percent of the PM in the exhaust. A destruction efficiency of 35 percent for particulate matter has been assumed for the calculations. A summary of the potential criteria pollutant emissions are presented in Table 3. Detailed criteria, HAP and TAP emission calculations are attached in Appendix A.

TABLE 3
Summary of Emissions
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Pollutant	Flare (tpy)	Engines (tpy)	Total (tpy)
Nitrogen oxides	10.3	61.5	71.8
Carbon Monoxide	51.3	6.6	57.9
Particulate Matter (PM2.5)	2.9	1.6	4.5
Non-Methane Organic Carbons	11.0	2.9	13.9
Sulfur Dioxide	0.1	0.03	0.13
Toxic Air pollutants	2.4	0.6	3.0

Data Tracking for Emissions Calculations

Fuel oil to the facility is measured using a mass flow meter. Landfill gas to the facility is metered using an orifice plate meter. The heat value of fuel oil is pegged at 137,000 Btu/gallon. The heat value of landfill gas is derived from the measured methane content. Fuel and landfill gas flow rates and meter totals are continuously recorded in an electronic database.

The engine controllers report various engine operating parameters including output (kW), fuel usage (fuel rate in gallons/hour) and gas fraction. These data are recorded continuously in the electronic database for each engine. The plant electronic database continuously updates a database in Richmond, Virginia. Plant data are retained at the facility only until the central database is updated.

The central database is queried for data for emissions calculations. The liquid fuel data is used to reconcile data reported by the engines to data reported by the meter. Gas fractions and engine fuel data are used to sort fuel data into three gas fraction ranges. Landfill gas is distributed by heat input according as a weighted fraction according to engine liquid fuel heat input and gas fraction and reconciled to the metered plant flow. Emissions are calculated based on the fuel heat value distribution and the site-specific factors. In the event that engine data are not available, the metered flows can give an overall gas fraction as a default calculation. This default slightly overestimates the emissions calculated using engine data, since it tends to result in lower gas fractions (higher emission rates).

Engine and fuel data are retrieved for each operating day and used for daily calculations. The daily fuel use, heat input by gas fraction range and emissions are summed for monthly emissions. Monthly emissions are summed for a rolling 12-month total. Emissions are calculated a minimum of monthly using the process described above, but may be calculated over shorter time intervals if required. In addition, emissions are reviewed periodically.

6. Best Available Control Technology Evaluation

Under the NSR rules, which are promulgated and enforced by Ecology and local air quality agencies, best available control technology (BACT) is required for construction and modification of specified stationary sources. For projects subject to these rules, BACT is required for any pollutant for which the emissions increase.

Chapter 173-460 WAC requires sources of toxic air pollutants (TAPs) in Washington State to first demonstrate that they will use BACT for toxics and then to demonstrate that the emissions will not exceed an acceptable source impact level (ASIL) identified in the rule. The process is referred to as T-BACT.

For sources of HAP emissions, the USEPA has developed Maximum Achievable Control Technology (MACT) standards for Stationary RICEs. The MACT for stationary RICEs was applicable only to facilities that are a major source of HAP emissions, but has recently been modified to include some non-major sources too.

Under WAC 173-460(12), Ecology defines BACT as:

> "… an emission limitation based on the maximum degree of reduction for each air pollutant subject to regulation under chapter 70.94 RCW emitted from or which results from any new or modified stationary source, which the permitting authority, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such source or modification through application of production processes and available methods, systems, and techniques, including fuel cleaning, clean fuels, or treatment or innovative fuel combustion techniques for control of each such pollutant. In no event shall application of the "best available control technology" result in emissions of any pollutants which will exceed the emissions allowed by any applicable standard under 40 CFR Part 60 and Part 61. Emissions from any source utilizing clean fuels, or any other means, to comply with this paragraph shall not be allowed to increase above levels that would have been required under the definition of BACT in the Federal Clean Air Act as it existed prior to enactment of the Clean Air Act Amendments of 1990."

In evaluating control technologies, the two primary control strategies are to modify the process and or raw materials in such a way to minimize emissions and to add control equipment. The Bio Energy facility includes a waste-gas thermal oxidizer and 12 Detroit

Diesel Series 60 engines modified by Bio Energy to operate on methane from the process and a pilot charge of diesel fuel, and each equipped with a 350 kW generator.

Top-Down BACT Process

The BACT requirements are intended to ensure that a proposed facility will incorporate control systems that reflect the latest techniques used in a particular industry, allow for future growth in the vicinity of the proposed facility, and do not result in the exceedance of National Ambient Air Quality Standard (NAAQS) or other standards imposed on the state level. The BACT evaluation requires the documentation of performance levels achievable for each air pollution control technology applicable to the facility under evaluation.

USEPA has developed a process for conducting BACT analyses. This method is referred to as the “top-down” method. The steps to conducting a “top-down” analysis are listed in EPA’s “New Source Review Workshop Manual,” Draft, October 1990. The steps included in the Manual are the following:

- Step 1—Identify All Control Technologies
- Step 2—Eliminate Technically Infeasible Options
- Step 3—Rank Remaining Control Technologies by Control Effectiveness
- Step 4—Evaluate Most Effective Controls and Document Results
- Step 5—Select BACT

The top-down approach ranks available control technologies in descending order of control effectiveness. This process allows for careful consideration of possible control trade-offs, especially when a control technology may generate other types of pollution. To be “available,” a technology must be effectively demonstrated in a commercial application under comparable operating conditions. After available technologies are compiled and ranked, the technologies must be evaluated for technical feasibility, starting with the most effective technology. A control technology can be considered infeasible because of technical considerations, energy requirements, environmental impacts, or economic impacts. If the most effective technology is eliminated in this fashion, then the next most effective alternative is evaluated using these same criteria. The process is repeated until either a technology is selected or there are no remaining technologies to consider. BACT and T-BACT analyses follow the same general approach and often result in the same outcome.

A BACT review was completed for the emissions from the destruction of the waste gas stream and the diesel engines.

BACT Search Resources

Several resources were accessed in order to identify potential control techniques including USEPA’s Clean Air Technology Center (CATC), the RACT/BACT/Lowest Achievable Emission Rate Clearinghouse (RBLC) database, and the California Air Pollution Control Officers Association (CAPCOA) BACT Clearinghouse and control equipment vendors.

- CATC is sponsored by the USEPA and contains technical reports which provide information on emissions and control technologies, and a control technology evaluation model called Air Compliance Advisor (ACA) Air Pollution Control Technology Evaluation Model, version 7.5. CATC is accessed at the following Web site: www.epa.gov/ttn/catc/products.html#aptecrpts.

- The RBLC database identifies types of controls and pollution prevention measures that have been applied to and/or are required for various sources permitted from State and local air pollution control programs in the United States, and the effectiveness of these technologies. The most current database available on the USEPA's Web site was used
- The CAPCOA BACT clearinghouse hosted by the California Air Resources Board (CARB) provides a searchable database of BACT requirements in permits issued by California Air Pollution Control Districts.

Thermal Oxidizer

A byproduct of the landfill gas treatment system is a waste gas stream consisting of carbon dioxide, methane and trace quantities of NMOC. The RBLC database shows that enclosed flares are commonly used at wastewater and landfill facilities to burn the digester gas or landfill gas.

Flaring is a volatile organic compound (VOC) combustion control process in which VOCs are piped to a remote, usually elevated, location and burned in an flame using a specially designed burner tip, auxiliary fuel, and steam or air to promote mixing for nearly complete (greater than 98 percent) VOC destruction. Completeness of combustion in a flare or thermal oxidizer is governed by flame temperature, residence time in the combustion zone, turbulent mixing of the gas stream components to complete the oxidation reaction, and available oxygen for free radical formation. Combustion is complete if all VOCs are converted to carbon dioxide and water. Incomplete combustion results in some of the VOCs being unaltered or converted to other organic compounds such as aldehydes or acids.

Thermal oxidizers can be used to control almost any VOC stream and can typically handle large fluctuations in VOC concentration, flow rate, heating value, and inert species content. The waste gas stream must have a heating value of greater than 300 Btu per standard cubic foot (scf). If this minimum is not met by the waste gas, auxiliary fuel must be introduced in sufficient quantity to make up the difference.

The PSCAA has previously approved thermal oxidation for the control of low Btu content gases for the digester gas at the West Point Treatment Plant and at the CHRL. In addition, recent BACT determinations have been conducted for the waste gas flares at the Salmon Creek Waste Water Treatment Plant (WWTP), the City of Pullman WWTP, and the Riverside Park Water Reclamation Facility. All three determinations have accepted 0.06 lbs NO_x/MMBtu and 0.3 lbs CO/MMBtu as BACT. Two of the permits also required 99 percent destruction removal efficiency; one required 98 percent destruction removal efficiency.

The thermal oxidizer at Bio Energy is designed to destroy the methane and trace quantities of NMOC in the waste gas stream that are byproducts of the gas processing facility. The composition of the waste gas stream is presented in Table 4.

TABLE 4
Thermal Oxidizer Waste Gas Composition
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Stream Compositions	Maximum (mole percent)	Minimum (mole percent)
CO_2	83.66	82.45
CH_4	11.31	9.32
O_2	2.93	2.26
N_2	2.92	1.73
H_2S	0.00	0.00
H_2O (V)	1.63	1.41

The thermal oxidizer is designed to meet emission limits of 0.06 lbs NO_x/MMBtu and 0.3 lbs CO/MMBtu as BACT. The flare is also design to have DE of 98 percent. The digester gas flares that were permitted with a 99 percent DE were combusting waste streams that contained 40 percent to 60 percent methane. The higher heat content of waste gas stream is part of what makes the higher DE possible. Waste gas stream with lower heat content are typically expected to meet 98 percent DE. As an example, 40 CFR 60 Subpart WWW, National Emission Standards for Hazardous Air Pollutants: Municipal Solid Waste Landfills requires landfill flares to meet the 98 percent DE.

Detroit Diesel Engines

The facility will have 12 Detroit Diesel Series 60 engines modified by Bio Energy to operate on methane from the process and a pilot charge of diesel fuel. Each engine will power a 350 kW generator. Electricity generated will be used the gas processing facility and will be supplemented by electricity from the grid. The facility will require about 6 MW of power to operate at full capacity. Bio Energy will produce about 3 MW of power from the operation of 10 generators deriving about 92 percent of the energy required for operation from the landfill gas processing facility. The remainder fuel for the generators will be supplied by diesel fuel. The power generating facility has the ability to generate up to 4 MW of power and may do so for short periods. The facility is designed for 100 percent redundancy. That is, the standard operation of the facility will be electricity produced from six engines with the remaining engines in place as backup. The facility can operate on 100 percent diesel fuel and can operate more than 6 engines. However, except for engine startup and shut down, which are done on 100 percent diesel fuel, it is expect that the electrical generating facility will operate in the dual-fuel mode as described above. In no case should any engine operate on diesel fuel for more than 500 hours per year.

A review of the BACT references mentioned above indicate that combustion and add on emission controls for diesel engines usually are for the control of NOx, CO and PM. For engines burning landfill gas and natural gas, BACT evaluation are typically conducted for NOx and CO. PM is usually low from engines burning natural gas or landfill gas and are typically controlled by good combustion control and not with add-on emission controls. For the Detroit Diesel engines, BACT has been evaluated for the control of emissions of NOx, CO, and particulate from the diesel engines. BACT for toxic air pollutants (T-BACT) has also been evaluated for formaldehyde.

Nitrogen Oxides

Step 1 – Identify All Control Technologies

NOx are gaseous pollutants that are primarily formed through combustion process. While exhaust gas is within the combustion unit, about 90 percent of the NOx exists in the form of nitric oxide (NO). The balance is nitrogen dioxide (NO_2), which is unstable at high temperatures. Once the flue gas is emitted into the atmosphere, most of the NOx is ultimately converted to NO_2. NOx in the atmosphere reacts in the presence of sunlight to form ozone (O_3), one of the criteria pollutants for which health-based National Ambient Air Quality Standards have been established.

NOx is generated in one of three forms; fuel NOx, thermal NOx, and prompt NOx. Fuel NOx is produced by oxidation of nitrogen in the fuel source. Combustion of fuels with high nitrogen content such as coal and residual oils produces greater amounts of NO_x than those with low nitrogen content such as diesel fuel and methane. Landfill gas does not contain a significant amount of fuel-bound nitrogen. Thermal NOx is formed by the fixation of molecular nitrogen and oxygen at temperatures greater than 1,800 degrees Fahrenheit (°F) (1,000 degrees Celsius [°C]). Prompt NOx forms from the oxidation of hydrocarbon radicals near the combustion flame and produces an insignificant amount of NOx. NOx emissions can be reduced by the use of combustion controls and post-combustion controls.

A review of the BACT references indicated that NOx emissions from engines burning landfill gas are typically controlled by combustion controls like lean burn design, air to fuel ratio controllers and good combustion practices. The Detroit Diesel engines are equipped with turbochargers and air-to-fuel ratio controllers.

Only two of the BACT determinations listed were for duel fuel, fuel oil and landfill gas, engines. The INGENCO facility installed in Virginia in 2003 has a NOx emission limit of 2.1 lbs/MMBtu. The Bio-Energy facility installed in Ohio in 2003 has a NOx emission limit of 0.36 lb/MMBtu. The variation in NOx emission limits is partially due to different ratios of diesel to landfill gas burned at the different locations. The engines being installed at the Bio Energy facility in at Cedar Hills are expected to meet 0.36 lb/MMBtu.

None of the landfill gas engines listed had post combustion controls. Engines burning methane or natural gas and equipped with post combustion NOx controls typically have Selective Catalytic Reduction (SCR). SCR control technology is based on the chemical reduction of NOx into molecular nitrogen (N_2) and water vapor ($H_2O[g]$). SCR systems reduce NOx emissions by injecting ammonia or urea into the exhaust stream prior to a catalyst. NOx and ammonia react on the surface of the catalyst to form water and nitrogen.

Step 2 – Eliminate Technically Infeasible Options

All of the BACT determinations reviewed from the USEPA and CARB databases indicated that post combustion control technology, in particular catalyst based controls such as SCR, were dismissed because the technologies were deemed infeasible for engines burning landfill gas. The infeasibility determination was made because contaminants in the landfill gas, in particular siloxanes, can plug and destroy the catalyst.

In theory the problem could be eliminated by using landfill gas treatment system, which can remove siloxanes and sulfur compounds from the landfill gas, upstream of the engines. However, tests conducted by INGENCO indicate that even with a gas treatment system, catalyst can last anywhere from three to 2000 hours. This is partially due to the fact that gas treatment systems are designed to remove siloxanes to a level necessary to protect the engine. The level of siloxane removal required to protect a catalyst system from plugging is significantly lower. Bio-Energy is developing a gas treatment system that may be able to remove siloxanes to the level necessary to protect the catalyst; however the technology is still unproven in practice. Catalysts on pipe line quality natural gas fired engines typically have a 16,000-hour lifetime.

Since, in theory, the catalyst could operate if a gas treatment system is also used upstream of the engines, the technology was not deemed infeasible at this point. The cost effectiveness of SCR was evaluated based on 2,000 hours of catalyst life.

BACT for diesel engines typically include control of charge air temperatures and, in some cases, retarded injection timing. Both are included in the design of this facility. Injection timing retardation reduces NOx. Also, NOx reductions are obtained by dual-fueling diesel engines.

Carbon Monoxide

CO forms as a result of incomplete combustion of fuel. CO emissions from engines are a function of oxygen availability, flame temperature, residence time at flame temperature, combustion zone design, and turbulence. These control factors, however, also result in high emission rates of NOx. Conversely, a low NOx emission rate achieved through flame temperature control can result in higher levels of CO emissions. Thus, a compromise is established whereby the flame temperature reduction is set to achieve the lowest NOx emission rate possible while keeping the CO emission rates at acceptable levels.

Alternative CO control methods include add-on control, such as catalytic oxidation, and front-end control, such as combustion controls wherein CO formation is suppressed.

A review of the BACT databases indicated that CO emissions from engines burning landfill gas are typically controlled by combustion controls like lean burn design, air to fuel ratio controllers and good combustion practices. The Detroit Diesel engines are equipped with turbochargers and air-to-fuel ratio controllers.

Only two of the BACT determinations listed were for a duel fuel, fuel oil and landfill gas, engine. The INGENCO facility installed in Virginia in 2003 has a CO emission limit of 3.2 lbs/MMBtu. The Bio-Energy facility installed in Ohio in 2003 has a CO emission limit of 0.67 lb/MMBtu. The engines being installed at the Bio-Energy facility in at Cedar Hills are expected to meet 1.65 lb/MMBtu without add on controls. The variation in CO emission limits is partially due to different ratios of diesel to landfill gas burned at the different locations.

None of the landfill gas engines listed had post combustion controls. Engines burning methane or natural gas which also have post combustion CO controls typically have catalytic oxidation.

In most applications, a diesel oxidation catalyst consists of a stainless steel canister that contains a honeycomb structure called a substrate or catalyst support. There are no moving parts, just large amounts of interior surface area. The interior surfaces are coated with catalytic metals such as platinum or palladium. It is called an oxidation catalyst because the device converts exhaust gas pollutants into fully oxidized gases such as carbon dioxide and water by means of chemical oxidation.

In the case of diesel exhaust, the catalyst oxidizes CO, VOCs, and the liquid hydrocarbons adsorbed on carbon particles. Liquid hydrocarbons adsorbed on the carbon particles in engine exhaust are referred to as the soluble organic fraction (SOF), the soluble part of the particulate matter in the exhaust. Diesel oxidation catalysts are efficient at converting the soluble organic fraction of diesel particulate matter into carbon dioxide and water. Therefore the application of an oxidizing catalyst for CO will also result in a reduction of VOC and particulate emissions. The HAP formaldehyde, a hydrocarbon, is also reduced.

The USEPA has established 40 CFR 63 Subpart ZZZZ – National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines. Under a January 18, 2008 amendment, these standards apply to both facilities that emit more than 10 tons per year of any HAP or more than 25 tons per year of all HAPs combined and to the sources that have lower emissions. The proposed facility will emit less than 10 tons per year of any HAP and less than 25 tons per year of all HAPs combine; hence it will be classified as an area source for HAPs. 40 CFR 63.6590(b) identifies stationary RICE subject to limited requirements to include a "stationary RICE with a site rating of less than or equal to 500 brake hp which combusts landfill or digester gas equivalent to 10 percent or more of the gross heat input on an annual basis," and "a CI stationary RICE with a site rating of less than or equal to 500 brake hp." The proposed engines will meet both of these requirements. For such engines Subpart ZZZZ only requires that they "must meet the requirements of this part by meeting the requirements of 40 CFR 60 Subpart IIII… . No further requirements apply for such engines under this part."

In addition for major sources or larger engines Subpart ZZZZ, Table 2A - Emission Limitations for New and Reconstructed Lean Burn and Compression Ignition Stationary RICE provides the following guidelines for CO emission control.

For Stationary CI engines:

a. Reduce CO emissions by 70 percent or more; or
b. Limit concentration of formaldehyde in the stationary RICE exhaust to 580 parts per billion volume, dry (ppbvd) or less at 15 percent oxygen.

Maintenance Procedures include:

a. Maintain your catalyst so that the pressure drop across the catalyst does not change by more than two inches of water at 100 percent load plus or minus 10 percent from the pressure drop across the catalyst that was measured during the initial performance test; and

b. Maintain the temperature of your stationary RICE exhaust so that the catalyst inlet temperature is greater than or equal to 450°F and less than or equal to 1,350°F.

The catalytic oxidizer proposed is designed for 95 to 99 percent DE of CO, 20 to 50 percent DE of particulate, and 95 to 99 percent DE of formaldehyde.

Step 2 – Eliminate Technically Infeasible Options

Since, in theory, the catalyst could operate if a gas treatment system is also used upstream of the engines, the technology was not deemed infeasible at this point. The cost effectiveness of catalytic oxidation was evaluated based on 2,000 hours of catalyst life.

Particulate Matter

Particulate matter (PM) is usually low from engines burning natural gas or landfill gas and is controlled by good combustion design and not with add-on emission controls. Diesel fuel fire engines are often equipped with add-on control technology in the form of diesel particulate filters (DPFs). As the name implies, diesel particulate filters remove particulate matter in diesel exhaust by filtering exhaust from the engine. By trapping the particulates as the exhaust gas passes through the filter, DPFs are able to achieve PM reductions of 80 to 90 percent. When the particulate filter is placed after an oxidizing catalyst, the catalyst will remove approximately 35 percent of the particulate and then the filter will remove 90 percent of the remaining 65 percent of particulate. Numerous studies have documented the effectiveness of DPFs in both on- and off-road applications, as well as stationary engines. The systems are relatively easy to maintain, but do require users to monitor their condition and occasionally remove the filter, blowing out the ash and replacing it.

Step 2 – Eliminate Technically Infeasible Options

All DPF are feasible, however the PM filter is typically used on compression ignition engines burning diesel fuel and not on engines burning natural gas, because of the already low particulate emission rates.

Formaldehyde

Formaldehyde is generated by the combustion of landfill gas in the engines. The BACT databases do not discussed control technologies for formaldehyde. However catalytic oxidation for the control of CO is also a control technology for hydrocarbons from engines. The catalytic oxidizer selected is designed for 95 to 99 percent control of CO and will also provide 95 to 99 percent control of formaldehyde.

Rank Remaining Control Technologies by Control Effectiveness All Pollutants – NOx, CO, PM, and Formaldehyde

The post-combustion technologies discussed above were evaluated for control effectiveness and cost effectiveness. SCR, catalytic oxidation, and particulate filters can be used separately or together. Evaluations where conducted for SCR, catalytic oxidation, SCR and catalytic oxidation, and particulate filters (Table 5).

TABLE 5
Control Effectiveness of Feasible Control Technologies
Notice of Construction Application

Type of Control	Percent Reduction	Potential Emission Control (tpy)
SCR for Nox	75	46.1
Oxidative Catalyst – CO	97	212
Oxidative Catalyst – PM	35	0.8
Oxidative Catalyst – Formaldehyde	97	12.9
Diesel Particulate filter	90	1.4

Step 4 – Evaluate Most Effective Controls and Document Results

An economic analysis of each BACT alternative was performed to compare capital and annual costs in terms of cost-effectiveness (dollars per ton of pollutant removed). Capital costs include the initial cost of components intrinsic to the complete control system. Annual operating costs consist of the financial requirements to operate the control system on an annual basis. The cost effectiveness of each option is listed in Table 6 below.

TABLE 6
Control Effectiveness of Controls
Notice of Construction Application

Bio Energy
BACT Cost
Cost for 12 engines

			SCR w/ammonia	Oxidation Catalyst	PM Filter
Equipment Cost (A)			215,554	31,248	500
Initial Catalyst Cost			27,554	62,256	14,400
Total Equipment Cost			243,108	93,504	14,900
Sales Tax	8.80% of Equipment		21,394	8,228	1,311
Freight	5% of Equipment		12,155	4,675	745
PURCHASED EQUIPMENT COST, PEC			276,657	106,408	16,956
Installation Cost	50% of PEC		107,777	15,624	1,000
TOTAL DIRECT CAPITAL COST			384,434	122,032	17,956
Engineering cost	10% of PEC		42,000	10,641	1,696
Field cost	10% of PEC		27,666	10,641	1,696
Start up cost	2.0% of PEC		5,533	2,128	339
Performance Test			7,000	10,000	0
Contingencies	3% of PEC		8,300	3,192	509
Total Indirect capital cost			90,499	36,602	4,239
TOTAL CAPITAL INVESTMENT, TCI			474,932	158,633	22,195
ANNUAL COSTS	Factor	Unit Cost	Total		
Operator	0.25 hr/shift	35 $/hr	2,275	2,275	2,275
Supervisor	15% of Operator		341	341	341
Operating Labor			2,616	2,616	2,616
Maintenance					
Operator	0.25 hr/shift	40 $/hr	2,600	2,600	2,600
Supervisor	15% of Operator		390	390	390
Maintenance Labor			2,990	2,990	2,990
Annual Catalyst Cost			134,164	272,681	7,200
Other Replacement Parts	0.1* A		21,555	3,125	50
Utilities	Output penalty (0.2% of MW output)		701	701	0
TOTAL DIRECT ANNUAL COST			162,026	282,113	12,856
Overhead		0.50%	810	1,411	64
Administrative Charges		2% TCI	9,499	3,173	444
Property Taxes		1% TCI	4,749	1,586	222
Insurance		1% TCI	4,749	1,586	222
Capital Recovery Factor		15% TCI	70,779	23,641	3,308
TOTAL INDIRECT ANNUAL COST			90,586	31,397	4,260
TOTAL ANNUAL COST			252,612	313,510	17,116
Pollutant to be Controlled			NOx	CO, PM, Formaldehyde	PM
Percent Control			75%	97%, 35%, 97%	90%
Annual pollutant rate to be controlled			46.10	62.96	1.39
Cost per Ton pollutant =			5,480	4,979	12,314

Step 5 – Select BACT

To evaluate the cost of each control option we obtained an engineering evaluation and cost proposal. To determine the cost effectiveness of add on technology total annualized cost must be divided by the ton of pollutant removed. The evaluation, as shown in Table 6, indicates that the uses of oxidative catalysts are cost effective and that SCR has the potential to be cost effective. Particulate matter controls are not cost effective; with a cost of over $12,000 per ton. However, the feasibility of using catalyst on engines fueled by landfill gas is still in question. The effectiveness of the landfill gas treatment system at consistently removing siloxanes to a level that will not affect the useful life of the catalyst is still unknown. At this time we propose installing oxidative catalyst on the engines but not SCR. Based on the information in the BACT databases; these will be the first landfill gas fired engines in the nation to have post combustion catalyst controls. Using oxidative catalyst instead of SCR or a combination of SCR and oxidative catalyst is a more cost effective way of evaluating if post combustion controls are feasible on landfill gas fired engines.

7. Ambient Impact Analysis

Model Selection

For all criteria pollutants and for those TAPs that exceeded the small quantity emission rate (SQER), the EPA recommended AERMOD dispersion modeling system was used to estimate air quality impacts. The AERMOD model is listed as a Preferred/Recommended model in 40 CFR 51 Appendix W, Guideline on Air Quality Models. AERMOD (Version 07026) was run with the following default options:

- Use stack-tip downwash
- Use of the PRIME algorithm for sources influenced by building downwash
- Use default wind profile exponents
- Use default vertical potential temperature gradients

Receptors

A Cartesian coordinate receptor grid was used to predict the ground-level concentrations surrounding the project area. The INGENCO facility is surrounded by a fence, which represents the ambient air boundary. All receptor coordinates were referenced to the universal transverse Mercator (UTM) Zone 10, North American Datum (NAD) 27. Receptor locations in AERMOD were selected as follows:

- Receptors were placed at 25-meter intervals around the fence line.
- A 25-meter grid extended approximately 2500 meters.
- A 100-meter grid extended approximately 1 kilometer.
- A 500-meter grid extended approximately 5 kilometers.

The AERMAP pre-processor (Version 06341) was used to determine elevation and hill height scale at each receptor. Digital Elevation Model (DEM) data were obtained from the U.S. Geological Survey (USGS) for use with AERMAP. Source base elevations, which are used in part to determine the height of the plume relative to the receptors, were also determined from AERMAP.

Meteorology

The meteorological data was processed using the USEPA's approved AERMET (Version 06341) meteorological data preprocessor, which is part of the AERMOD air dispersion modeling system. The AERMET dataset used U.S. National Climatic Data Center (NCDC) surface observations from the SeaTac Airport, Washington, surface station and twice daily upper-air soundings data from Spokane, Washington. Five years of data (i.e., 2002, 2003, 2004, 2005, and 2006) were used for the analysis.

Building Wake Downwash Parameters

The USEPA's Building Profile Input Program (BPIP-PRIME) (dated 04274) was used to calculate the projected building dimensions required for the AERMOD evaluation of impacts from building downwash.

Source Characterization

Three emission sources were included in the dispersion modeling analysis. The sources included two generator stacks and one flare. Each generator stack has the emissions from one group of six engines. All sources were represented as point sources. Point source parameters are presented in Table 7.

TABLE 7
Point Source Parameters
Notice of Construction Application

Source ID	Description	Release Height (feet)	Temperature (°F)	Exit Velocity (feet/second)	Stack Diameter (feet)
STK01	Generator Stack	50	872	187	1.02
STK02	Generator Stack	50	872	187	1.02
FLARE	Flare	50	1700	26.2	9.5

Toxic Air Pollutants

An analysis was performed to demonstrate that the expected ambient impact of each TAP emitted by the entire facility (i.e., generators and flare) will not exceed an ASIL listed in the regulation (WAC 173-460-110). If the expected emissions are below an SQER identified in WAC 173-460-080(e), no further air quality impact analysis is typically required. If the emissions are above the SQER, ambient air quality modeling is required.

Emission estimates for TAPs for compounds expected to be emitted were calculated as described in Section 5 Emissions Estimates. As shown in Table 8, potential emissions of a number of pollutants are less than the corresponding SQER. According to WAC 173-460-080(2)(e), modeling is not required if the SQERs are not exceeded. Ambient air quality modeling was performed to determine compliance with the ASILs for acetaldehyde, chloroform, formaldehyde, hydrogen chloride, phenanthrene, and nitric oxide.

TABLE 8
Modeled Emission Rates
Notice of Construction Application

Compound	Total Emissions (lb/yr)	Total Emissions (lb/hr)	SQER (lb/yr)	SQER \ (lb/hr)	Modeling Required? (Y/N)
1,1-Dichloroethane	1.33E+01	1.52E-03	43,748	5.0	N
1,2,4-trimethylbenzene	1.13E+02	1.29E-02	43,748	5.0	N
1,2-dichloroethane	2.66E+00	3.04E-04	10		N
1,3,5-trimethylbenzene	1.06E+02	1.21E-02	43,748	5.0	N
1,4 Dichlorobenzene	5.28E-01	6.03E-05	500		N
2-Butanone	4.17E+02	4.76E-02	43,748	5.0	N
4-Methyl-2-pentanone (MIBK)	5.38E+01	6.15E-03	43,748	5.0	N
1-Methylnaphthalene	7.24E-01	8.26E-05	22,750	2.6	N
2-Methylnaphthalene	1.90E+00	2.16E-04	22,750	2.6	N
Acetaldehyde	4.69E+01	5.36E-03	50		N
Acetone	4.90E+02	5.60E-02	43,748	5.0	N
Benzene	6.72E+01	7.67E-03	**20**		**Y**
Chloroethene (Vinyl Chloride)	5.94E-01	6.78E-05	10		N
Chloroform	2.25E+01	2.56E-03	**10**		**Y**
Chloromethane	3.28E+01	3.75E-03	43,748	5.0	N
cis-1,2-dichloroethene	2.87E+01	3.27E-03	43,748	5.0	N
Cyclohexane	8.82E+01	1.01E-02	43,748	5.0	N
Dichlorodifluoromethane (Freon 12)	7.80E+01	8.91E-03	43,748	5.0	N
Ethanol	7.31E+01	8.34E-03	43,748	5.0	N
Ethyl Acetate	3.32E+01	3.78E-03	43,748	5.0	N
Ethylbenzene	3.62E+02	4.14E-02	43,748	5.0	N
Formaldehyde	8.42E+02	9.62E-02	**20**		**Y**
Hydrogen Chloride	1.93E+02	2.21E-02	**175**	**0.02**	**Y**
Heptane	1.16E+02	1.32E-02	43,748	5.0	N
Hexane	2.48E+02	2.83E-02	22,750	2.6	N
Isopropyl alcohol	4.01E+02	4.57E-02	43,748	5.0	N

TABLE 8
Modeled Emission Rates
Notice of Construction Application

Compound	Total Emissions (lb/yr)	Total Emissions (lb/hr)	SQER (lb/yr)	SQER \ (lb/hr)	Modeling Required? (Y/N)
m/p-Xylene	7.56E+02	8.63E-02	43,748	5.0	N
Methyl-t-butyl ether (MTBE)	4.74E-01	5.41E-05	43,748	5.0	N
Methylene Chloride	4.04E-01	4.61E-05	50		N
Naphthalene	1.41E+00	1.61E-04	22,750	2.6	N
Naphthalene - Total	4.03E+00	4.60E-04	22,750	2.6	N
o-Xylene	1.86E+02	2.12E-02	43,748	5.0	N
Phenanthrene	2.88E+00	3.28E-04	**none**		**Y**
Styrene	7.96E+00	9.09E-04	43,748	5.0	N
Tetrachloroethylene	5.01E+01	5.72E-03	500		N
Tetrahydrofuran	1.36E+02	1.55E-02	43,748	5.0	N
Toluene	7.53E+02	8.59E-02	43,748	5.0	N
Tribromomethane	5.44E+01	6.21E-03	50		N
Trichloroethylene	3.61E+01	4.12E-03	50		N
Trichloromonofluoromethane	2.22E+01	2.54E-03	43,748	5.0	N
Vinyl acetate	1.30E+02	1.48E-02	22,750	2.6	N
Nitric Oxide	**110,000**	**12.3**	**17,500**	**2.0**	**Y**

Model Results

The TAPs were modeled using a unit emission rate of one gram per second. For most of the TAPs for which modeling was required, emissions were either from the generators or the flare only. Results from these TAPs were scaled by the appropriate emission rate and then compared to their respective ASIL. Benzene and nitric oxide emissions were from all sources, and the model was run with the actual benzene and NO emission rates. As shown in Table 8, all pollutant concentrations were below their respective ASIL.

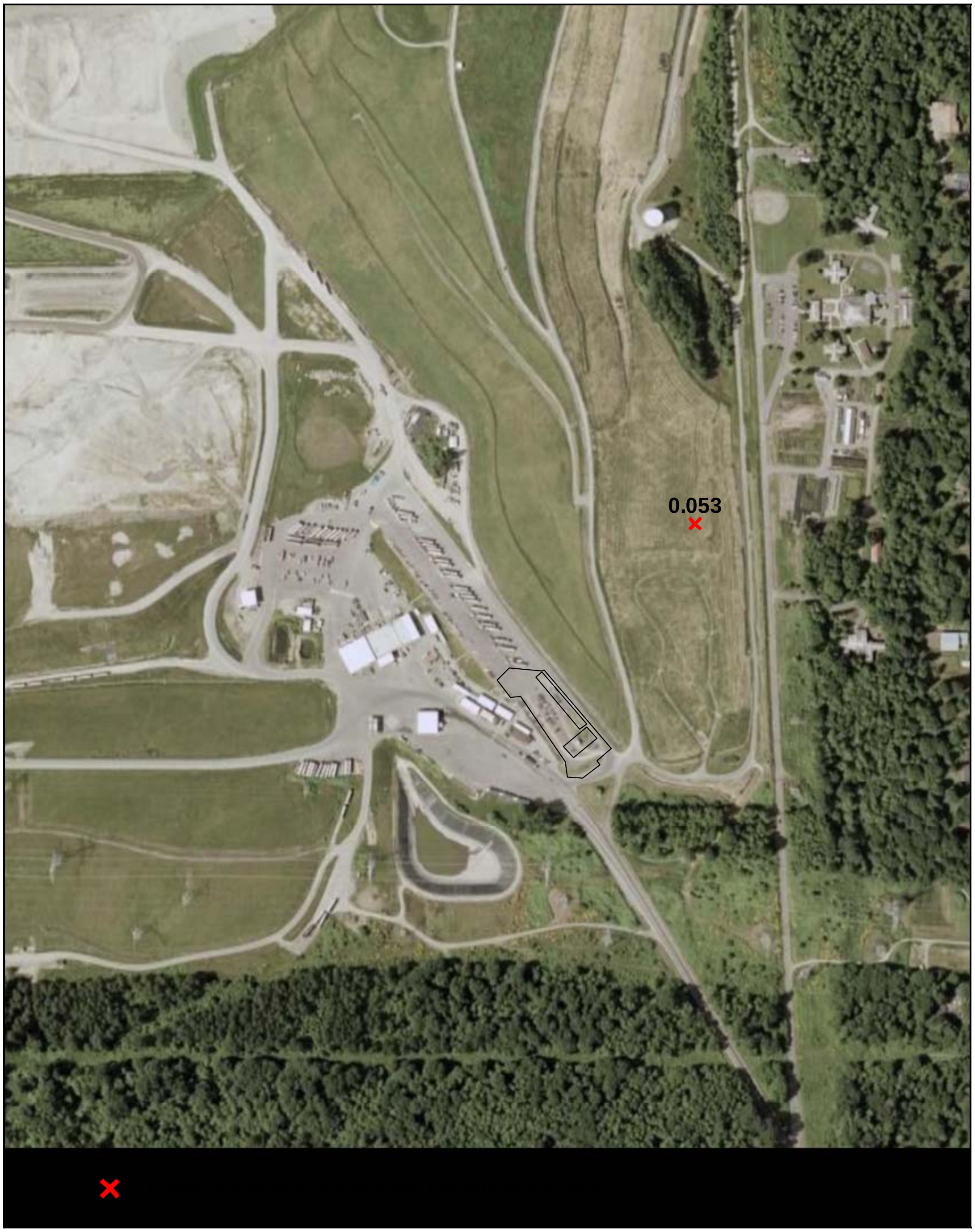
Figure 3 shows the location of maximum formaldehyde concentration in relation to nearby public locations. All modeling input and output files are available electronically upon request.

TABLE 9
Modeled Emission Rates
Notice of Construction Application

Compound	Generator Emissions (g/s)	Flare Emissions (g/s)	Unit Impact (μg/m³)	Modeled Impact (μg/m³)	ASIL (μg/m³)	Type[1]
Benzene	2.41E-04	7.25E-04	NA	1.25E-03	0.120	A
Chloroform		3.23E-04	0.41	1.4E-03	0.043	A
Formaldehyde	1.21E-02		4.4	0.05	0.077	A
Hydrogen Chloride	2.78E-03		25.5	7.1E-02	7.0	B
Phenanthrene	4.13E-05		4.4	1.82E-04	0.00048	A
Nitric Oxide	1.29	0.26	NA	32.8	100	B

[1] ASIL for type A pollutants is an annual average. ASIL for type B pollutants is a 24-hour average.

FIGURE 3
Location of Formaldehyde Maximum Impact



APPENDIX A

PSCAA Form P

PUGET SOUND CLEAN AIR AGENCY

ENGINEERING DIVISION

110 UNION STREET, ROOM 500, Seattle, Washington 98101-2038
(206) 689-4052 Fax: (206) 343-7522 <www.pscleanair.org>

Notice of Construction and Application for Approval

Incomplete applications may delay Agency review

FORM P
SIDE 1

Be sure to complete items 39, 40, 41, & 43 before submitting Form P.

(AGENCY USE ONLY)
DATE ________________ N/C NUMBER____________
REG. NO.______________ SIC/NAICS________________

1. TYPE OF BUILDING (Check) ☒ New ☐ Existing	2. STATUS OF EQUIPMENT (Check) ☒ New ☐ Existing ☐ Altered ☐ Relocation	7. APPLICANT NAME & MAILING ADDRESS Robert L. Greene, 2250 Danby Road, Richmond, VA. 23230

3. COMPANY (OR OWNER) NAME **Bio Energy (Washington), LLC.**	8. APPLICANT EMAIL ADDRESS rgreene@ingenco.dom
4. COMPANY (OR OWNER) MAILING ADRESS 2250 Dabney Road, Richmond, VA. 23230	9. INSTALLATION ADDRESS (Include City & Zip Code) 16645 228th Street, Maple Valley, WA. 98030 (Subject to change when lease signed and zoned)

5. PHONE NUMBER: 804-521-3557 FAX NUMBER: 804-521-3583	6. NATURE OF BUSINESS Biogas to Energy	10. TYPE OF PROCESS Convert biogas to pipeline gas and electricity.

EQUIPMENT (ENTER ONLY NEW EQUIPMENT OR CHANGES. ENTER NUMBER OF UNITS OF EQUIPMENT IN COLUMN 'NO OF UNITS.' COMPLETE FORM 'S' FOR EACH ENTRY)

11. NO. OF UNITS	SPACE HEATERS OR BOILERS	14. NO. OF UNITS	OVENS	15. NO. OF UNITS	MECHANICAL EQUIP.	16. NO. OF UNITS	MELTING FURNACES
(a)		(a) ___	CORE BAKING OVEN	(a) ___	AREAS	(a) ___	POT
12. NO. OF UNITS	INCINERATORS	(b) ___	PAINT BAKING	(b) ___	BULK CONVEYOR	(b) ___	REVERBERATORY
		(c) ___	PLASTIC CURING	(c) ___	CLASSIFIER	(c) ___	ELECTRIC
(a) 2	Thermal Oxidizer, Flare	(d) ___	LITHO COATING OVEN	(d) ___	STORAGE BIN	(d) ___	INDUC/RESIST
13. NO. OF UNITS	OTHER SYSTEMS	(e) ___	DRYER	(e) ___	BAGGING	(e) ___	CRUCIBLE
		(f) ___	ROASTER	(f) ___	OUTSIDE BULK STORAGE	(f) ___	CUPOLA
		(g) ___	KILN	(g)	LOADING OR UNLOADING	(g) ___	ELECTRIC ARC
(a) ___	DEGREASING, SOLVENT	(h) ___	HEAT-TREATING	(h) ___	BATCHING	(h) ___	SWEAT
(b) ___	ABRASIVE BLASTING	(i) ___	OTHER	(i) ___	MIXER (SOLIDS)	(i) ___	OTHER METALLIC
(c) 12	OTHER- SYSTEM Engines/Generators	(j) ___		(j) ___	OTHER	(j) ___	GLASS
-							OTHER NON METALLIC

17. NO. OF UNITS	GENERAL OPER. EQUIP.	17. NO. OF UNITS	GENERAL OPER. EQUIP.	17. NO. OF UNITS	GENERAL OPER. EQUIP.	18. NO. OF UNITS	OTHER EQUIPMENT
(a) ___	CHEMICAL MILLING	(f) ___	GALVANIZING	(k) ___	ASPHALT BLOWING	(a) ___	SPRAY PAINTING GUN
(b) ___	PLATING _____	(g) ___	IMPREGNATING	(l) ___	CHEMICAL COATING	(b) ___	SPRAY BOOTH OR
(c) ___	DIGESTER	(h) ___	MIXING OR FORMULATING	(m) ___	COFFEE ROASTER	(c) ___	ROOM
(d) ___	DRY CLEANING	(i) ___	REACTOR	(n) ___	SAWS & PLANERS	(d) ___	FLOW COATING
(e) ___	FORMING OR MOLDING	(j) ___	STILL	(o) 3_	STORAGE TANK 1-10k fuel oil and 2-500 gal lube oil	(e) ___	FIBERGLASSING
							OTHER

CONTROL DEVICES (ENTER NUMBER OF UNITS OF EQUIPMENT IN SPACES IN COLUMNS. COMPLETE A FORM R FOR EACH ENTRY)

19. NO. OF UNITS	CONTROL DEVICE	20. NO. OF UNITS	CONTROL DEVICE	21. NO. OF UNITS	CONTROL DEVICE	22. NO. OF UNITS	CONTROL DEVICE
(a) ___	SPRAY CURTAIN	(a) ___	AIR WASHER	(a) ___	ABSORBER	(a) ___	DEMISTER
(b) ___	CYCLONE	(b) ___	WET COLLECTOR	(b) ___	ADSORBER	(b) ___	BAGHOUSE
(c) ___	MULTIPLE CYCLONE	(c) ___	VENTURI SCRUBBER	(c) ___	FILTER PADS (FILTERS	(c) ___	ELEC. PRECIPITATOR
(d) ___	INERTIAL COLL.- OTHER	(d) ___	DUST COLLECTOR	(d) ___	AFTERBURNER	(d) 13	OTHER – 12 Oxidative Catalyst + 1 TO

23. BASIC EQUIPMENT COST (ESTIMATE) EXISTING $30,000,000.00	24. CONTROL EQUIPMENT COST (ESTIMATE) EXISTING $500,000.00	25. DAILY HOURS FROM 6 AM to 6 AM 24 hours/day	26. DAYS OF OPERATION ☒ S ☒ M ☒ T ☒ W ☒ T ☒ F ☒ S

27. ESTIMATED STARTING DATE OF CONSTRUCTION: June 15 2008	28. ESTIMATED COMPLETION DATE OF CONSTRUCTION: September 30, 2008

Your application <u>will</u> <u>not</u> <u>be</u> processed unless you mail a $750 filing fee payment *along with this application* to this Agency at the address noted at the top of this form. Additional fees may apply after your application is reviewed.

Notice of Construction Application

Side 2

FORM P

STACKS OR VENTS (LIST NUMBER, TYPE, AND SIZE OF VENT)

29. RAW MATERIALS (List materials used in process) AND FUELS (Type and amount)	ANNUAL AMT. UNITS	30. PRODUCTS (List End Products)	ANNUAL PROD. UNITS
(a) Landfill gas	5.78 MMcf/yr	(a) Methane	$2.1x10^9$ cf 97%CH_4
(b) Diesel fuel	146,000 gallons	(b) Electricity-used internally, not exported	~27,000 MW
(c)		(c)	

31. NO. OF UNITS	DESCRIPTION OF OPENING	32. HEIGHT ABOVE GRADE (FT.)	33. VOLUME EXHAUSTED	DIMENSIONS (INCHES)	
				34. LENGTH (OR DIAM)	35. WIDTH
(a) 2	GENERATOR STACKS	50 feet	9168 CFM	1.02 Feet	
(b) 1	THERMAL OXIDIZER	50	111,500 ACFM	9.5 Feet	
(c) _____	PROCESS OR GENERAL EXHAUST				
(d) _____	PROCESS OR GENERAL VENTS				
(e) _____	SKYLIGHT OR WINDOW				
(f) _____	EXHAUST HOOD				
(g) _____	OTHER				

FLOW DIAGRAM

36. FLOW DIAGRAM INSTRUCTIONS:

(a) FLOW DIAGRAM MAY BE SCHEMATIC. ALL EQUIPMENT SHOULD BE SHOWN WITH EXISTING EQUIPMENT SO INDICATED.
(b) SHOW FLOW DIAGRAM OF PROCESS STARTING WITH RAW MATERIALS USED AND ENDING WITH FINISHED PRODUCT.
(c) IF MORE THAN ONE PROCESS IS INVOLVED TO MAKE FINISHED PRODUCT, SHOW EACH PROCESS AND WHERE THEY MERGE.
(d) INDICATED ALL POINTS IN PROCESS WHERE GASEOUS OR PARTICULATE POLLUTANTS ARE EMITTED.
(e) FLOW CHART CAN BE ATTACTED SEPARATELY IF NECESSARY. (DRAWINGS MAY BE SUBMITTED INSTEAD IF DESIRED.)
(f) SHOW PICKUP AND DISCHARGE POINTS FOR HANDLING OR CONVEYING EQUIPMENT.

Flow diagram in attached
permit application.

37. PLEASE INCLUDE THE FOLLOWING SUPPORTING MATERIALS WITH THIS APPLICATION:
ENVIRONMENTAL CHECKLIST IS ATTACHED (OR A COPY OF AN APPROVED ENVIORNMENTAL CHECKLIST OR EIS)
PROCESS DESCRIPTION
VENDOR PRODUCT INFORMATION

38. CERTIFICATION:
I, THE UNDERSIGNED, DO HEREBY CERTIFY THAT THE INFORMATION CONTAINED IN THE APPLICATION AND THE ACOMPANYING FORMS, PLANS, AND SUPPLEMENTAL DATA DESCRIBED HEREIN IS, TO THE BEST OF MY KNOWLEDGE, ACCURATE AND COMPLETE.

39. SIGNATURE		40. DATE
41. TYPE OR PRINT NAME Robert L. Greene	42. TITLE Environmental Director	43. PHONE 804-521-3557

APPENDIX B

BACT Review

Bio Energy (Washington), LLC
BACT Database Review

FACILITY NAME	STATE	DATE	RBLCID	THRUPUT	UNIT	PROCESS NOTES	POLLUTANT	CONTROL	CONTROL DESCRIPTION	LIMIT	UNIT
UNIVERSITY OF NEW HAMPSHIRE	NH	7/25/2007	*NH-0014	14.3	MMBTU/HR	TWO 1,600 KW INTERAL COMBUSTION ENGINES FIRING ON LANDFILL GAS (LFG). THE LFG WILL BE SENT THROUGH A MOISTURE SEPARATOR, WHICH WILL HAVE AN INTERNAL MESH PAD FILTER TO COLLECT WATER DROPLETS AND SOME PARTICULATE. THE ENGINES WILL BE EQUIPPED	Nitrogen Oxides (NOx)	N	COMBUSTION CONTROLS (LEAN BURN DESIGN, AIR/FUEL RATIO CONTROLLER, INTERCOOLER, GOOD COMBUSTION PRACTICES)	0.5	G/BHP-HR
							Carbon Monoxide	N	GOOD COMBUSTION PRACTICES	2.75	G/BHP-HR
							Particulate Matter < 10 ? (PM10)	N	FILTERING OF INLET AIR	0.1	G/BHP-HR
MONMOUTH COUNTY RECLAMATION CENTER	NJ	12/12/2006	NJ-0069	183,263,744	SCF/YR	IC ENGINE: LEAN BURN ENGINE ,JENBACHER, MODEL JGS 320 GS-L.L, 9.81 MMBTU/H, 1468 BHP, 1000 KW	Nitrogen Oxides (NOx)	N		0.53	G/B-HP-H
							Carbon Monoxide	N		2.53	G/B-HP-H
							Total Suspended Particulates	N		0.58	LB/H
							Particulate Matter < 10 ? (PM10)	N		0.58	LB/H
MANCHESTER RENEWABLE POWER CORPORATION	NJ	10/6/2006	*NJ-0068			THE FACILITY PROPOSES TO INSTALL 6 (SIX) NEW IDENTICAL LEAN BURN CATERPILLAR LANDFILL GAS FUELED ENGINES. EACH ENGINE IS RATED AT 16.38 MMBTU/HR , 2233BHP & 1600 KW. FUEL TYPE IS LIMITED TO TREATED LANDFILL GAS.THE LANDFILL GAS IS TREATED BY CONDITIONING WITH	Nitrogen Oxides (NOx)	P	AIR TO FUEL RATIO CONTROL TECHNOLOGIES TO MINIMIZE THE AMOUNT OF NOX EMISSIONS.	0.5	G/BHP-HR
							Carbon Monoxide	N		2.75	G/BHP-HR
							Particulate Matter < 10 ? (PM10)	P		0.2	G/BHP-HR
							Particulate Matter < 2.5 ? (PM2.5)	P		0.2	G/BHP-HR
BURLINGTON COUNTY RESOURCE RECOVERY COMPLEX	NJ	8/3/2006	NJ-0067	12.5	MMBTU/H	THERE ARE FIVE NEW (5) JENBACHER LANDFILL GAS FIRED INTERNAL COMBUSTION ENGINES. EACH ENGINE IS RATED AT 12.5 MMBTU/HR AND 1500 KW.THEY ARE USED FOR PRODUCING	Nitrogen Oxides (NOx)	N	GOOD COMBUSTION.	0.6	G/B-HP-H
							Carbon Monoxide	N		2.5	G/B-HP-H
							Particulate Matter < 10 ? (PM10)	N		0.00	G/B-HP-H
							Total Suspended Particulates	N		0.00	G/B-HP-H
RIDGEWOOD RHODE ISLAND GENERATION LLC	RI	1/5/2005	*RI-0022	2229	Horsepower	LEAN BURN, SPARK IGNITED, AIR/FUEL RATIO CONTROLLERS, INTERCOOLERS	Nitrogen Oxides (NOx)	P	LEAN BURN, AIR/FUEL RATIO CONTROLLERS, INTERCOOLERS	0.5	G/B-HP-H
							Carbon Monoxide	P	GOOD COMBUSTION PRACTICES	2.75	G/B-HP-H
							Particulate Matter < 10 ? (PM10)	P	GOOD COMBUSTION PRACTICES	0.1	G/B-HP-H
NEW ENGLAND WASTE SERVICES OF VERMONT, INC.	VT	12/16/2004	VT-0019	2028	SCFM	THE PROCESS IS PERMITTED FOR FOUR INTERNAL COMBUSTION ENGINES EACH DRIVING AN	Carbon Monoxide	P	LOW EMISSION ENGINE DESIGN	2.75	G/B-HP-H
							Nitrogen Dioxide (NO2)	P	LOW EMISSION ENGINE DESIGN	0.5	G/B-HP-H
BIO ENEERGY TEXAS LLC	TX	7/23/2004	TX-0495			THE PROPOSED COVEL GARDENS LANDFILL GAS (LFG) POWER STATION WILL UTILIZE LFG FROM THE NEIGHBORING WASTE MANAGEMENT, INC. COVEL GARDENS LANDFILL TO PRODUCE ELECTRICITY. WASTE MANAGEMENT WILL SELL THE LFG TO ENERGY DEVELOPMENTS INC. (EDI), (THE FUTURE OPERATOR OF THE COVEL GARDENS POWER STATION) AFTER THE GAS IS EXTRACTED AND COMPRESSED. THE GAS WILL BE ROUTED TO THE LFG TREATMENT SYSTEM WHERE IT IS	Nitrogen Oxides (NOx)	B	THE COMPANY WILL USE LEAN-BURN TECHNOLOGY TO CONTROL NOX EMISSIONS TO A LEVEL OF 0.6 G/B-HP-H PER ENGINE. FLUE GAS TREATMENT CONTROLS SUCH AS NON-SELECTIVE CATALYTIC REDUCTION (NSCR) AND SELECTIVE CATALYTIC REDUCTION (SCR) A (text missing, should be "ARE DEEMED INFEASIBLE")	0.6	G/B-HP-H

Bio Energy (Washington), LLC
BACT Database Review

BIO ENEERGY TEXAS LLC	TX	7/23/2004	TX-0495			THE PROPOSED COVEL GARDENS LANDFILL GAS (LFG) POWER STATION WILL UTILIZE LFG FROM THE NEIGHBORING WASTE MANAGEMENT, INC. COVEL GARDENS LANDFILL TO PRODUCE ELECTRICITY. WASTE MANAGEMENT WILL SELL THE LFG TO ENERGY DEVELOPMENTS INC. (EDI), (THE FUTURE OPERATOR OF THE COVEL GARDENS POWER STATION) AFTER THE GAS IS EXTRACTED AND COMPRESSED. THE GAS WILL BE ROUTED TO THE LFG TREATMENT SYSTEM WHERE IT IS COMPRESSED (VIA BLOWERS), THE LIQUID IS REMOVED (VIA KNOCK-OUT AND CHILLING), AND THE PARTICULATE IS REMOVED (VIA FILTER). ONCE THROUGH THE LFG TREATMENT SYSTEM, THE GAS WILL BE ROUTED TO EIGHT POWER GENERATION UNITS WHICH EACH CONTAIN A CATERPILLAR MODEL G3520C INTERNAL COMBUSTION ENGINE, AN ELECTRICAL GENERATOR AND AUXILIARY SYSTEMS. THE ENGINES ARE LEAN-BURN, FOUR STROKE, TURBOCHARGED, AFTERCOOLED UNITS EACH RATED AT 2,172 BHP. EACH ENGINE IS COUPLED TO A GENERATOR AND WILL PRODUCE	Nitrogen Oxides (NOx)	B	THE COMPANY WILL USE LEAN-BURN TECHNOLOGY TO CONTROL NOX EMISSIONS TO A LEVEL OF 0.6 G/B-HP-H PER ENGINE. FLUE GAS TREATMENT CONTROLS SUCH AS NON-SELECTIVE CATALYTIC REDUCTION (NSCR) AND SELECTIVE CATALYTIC REDUCTION (SCR) A (text missing, should be "ARE DEEMED INFEASIBLE")	0.6	G/B-HP-H
							Carbon Monoxide	P	PROPER OPERATION AND MAINTENANCE WILL CONTROL CO TO A LEVEL OF 2.80 G/BHP-HR PER ENGINE. FLUE GAS CONTROLS WERE REJECTED	2.8	G/B-HP-H
							Particulate Matter < 10 ? (PM10)	P	GAS PRETREATMENT AND PROPER OPERATION AND MAINTENANCE OF THE ENGINES WILL CONTROL PM10 TO A LEVEL OF 0.71 LB/HR PER ENGINE. GAS PRETREATMENT CONSISTS OF A CONDENSATE KNOCKOUT TANK, FOLLOWED BY A BLOWER, A 10 MICRON FILTER, A	0.00	G/B-HP-H
CARLTON FARMS LANDFILL	MI	12/23/2003	MI-0371	8.6	MMBTU/H	THE ADDITIONAL ENGINES WILL INCREASE CAPACITY AT THE FACILITY BY 4.9 MW FROM THE	Nitrogen Oxides (NOx)	N	GOOD COMBUSTION PRACTICE	4.52	LB/H
							Carbon Monoxide	N	GOOD COMBUSTION PRACTICE	7.28	LB/H
(BIO-ENERGY, LLC)	VA	12/17/2003	VA-0288	550	HP	36 Detroit diesel engines, arranged in 6 groups of 6 engines each. Each engine drives a 350 kW generator. Treated landfill gas input ratio is limited to < 50%, treated landfill gas input to total fuel heat input for each period of continuous dual fuel operations. Compliance with lb/MMBtu limits for PM, PM10, VOC, CO and NOx, determined by stack testing.	Particulate Matter < 10 ? (PM10)	P	PROPER ENGINE MAINTENANCE PRACTICES	0.11	LB/MMBTU
							Nitrogen Oxides (NOx)	P	AIR-TO-FUEL RATIO CONTROL, TURBOCHARGING, CHARGE- AIR COOLING SYSTEMS, SUPPLEMENTARY INLET CHARGE- AIR WATER-TO-AIR COOLING AND OVERSIZED INLET CHARGE AND EXHAUST DUCTS.	2.1	LB/MMBTU
							Carbon Monoxide	P	FUEL LIMIT: TREATED LANDFILL GAS HEAT INPUT RATIO < 50%	3.2	LB/MMBTU

BIO-ENERGY, LLC_CARBON LIMESTONE LFG	OH	4/10/2003	OH-0260	14	MMBTU/H	SIXTEEN 14 MMBTU/H (1400 KW, 1877 HP) INTERNAL COMBUSTION ENGINES BURNING LANDFILL GAS FOR ELECTRICAL POWER. STACK TESTING WAS CONDUCTED ON ONE OF THE 16 SIMILAR UNITS, FOR NOX, CO, PM, HCL AND OCS. IT WAS FOUND THAT NOX, CO, AND HCL DID NOT MEET THE LIMITS IN THE ORIGINAL PERMIT; IT WAS MODIFIED TO INCREASE THESE LIMITS, AND RE-ISSUED ON 4/10/03. THE WAS AN INCREASE OF 170 TONS OF NOX, 79 TONS CO, AND 6 TONS OF HCL. LANDFILL GAS SHALL BE DIVERTED TO AN EXISTING LANDFILL COMBUSTOR, WHEN NOT BURNED IN THE INTERNAL COMBUSTION ENGINES. THE ALLOWABLE GAS FLOW RATE TO THE INTERNAL COMBUSTION ENGINES SHALL BE EXTABLISHED DURING THE MOST RECENT COMPLIANCE TEST; CURRENTLY THIS IS 415 SCFM.	Nitrogen Oxides (NOx)	P	LEAN BURN TECHNOLOGY.	0.36	LB/MMBTU	0.36	LB/MMBTU
							Carbon Monoxide	N		0.67	LB/MMBTU	0.67	LB/MMBTU
							Particulate Matter < 10 ? (PM10)	N		0.029	LB/MMBTU	0.002	LB/MMBTU
							Formaldehyde	N					
MM SAN BERNARDINO ENERGY, LLC	CA	5/16/2002	CA-1092	14.7	MMBTU/H 1850 BHP	EQUIP: , MFR: DUETZ, TYPE: TURBOCHARGED/INTERCOOLED, MODEL: TBG620V16K, FUNC EQUIP: POWER GENERATION, FUEL_TYPE: , SCHEDULE: CONTINUOUS, H/D: 24, D/W: 7, W/Y: 52, NOTES: PPMVD@15%O2: NOX-46, CO-360, HC-79. G/HP-HR: ROG <.02, PM-10 <.05 (BASED ON 34% (HHV) ENGINE EFFICIENCY USED BY THE MANUFACTURE IN HIS CALCULATIONS, THE PPMVD LIMITS CORRESPOND TO THE FOLLOWING G/HP-HR: NOX-0.61, CO-2.9, HC-0.36 (AS METHANE). SOURCE TEST RESULTS:	Nitrogen Oxides (NOx)	A	TURBOCHARGED,INTERCOOLED AIR/FUEL CONTROLLER	0.6	G/B-HP/H		
							Carbon Monoxide	A	TURBOCHARGED,INTERCOOLED AIR/FUEL CONTROLLER	2.5	G/B-HP/H		
							Particulate Matter (PM)	A		0.2	LB/H		
RELIANT SECURITY LFGTE	TX	1/31/2002	TX-0404	1664	KW	THROUGHPUT IS FOR EACH. THE ENGINES ARE JENBACHER MODEL JGS 616. LANDFILL GAS LIMITED TO 11.9 GR/100 DSCF H2S AND 13.2 GR/100 DSCF S.	Nitrogen Oxides (NOx)	P	GOOD COMBUSTION PRACTICE	0.6	G/BHP-H	3.1	T/YR
							Carbon Monoxide	P	GOOD COMBUSTION PRACTICE	3	G/BHP-H	15.5	T/YR
							Particulate Matter < 10 ? (PM10)	P	GOOD COMBUSTION PRACTICE, LOW SULFUR FUEL	0.84	T/YR		
RELIANT ENERGY GALVESTON PLANT	TX	1/24/2002	TX-0385	12	MW (TOTAL)	SULFUR COMPOUND LIMITED TO: 13.2 GRAINS H2S/100 DSCF 11.9 GRAINS TOTAL S/100 DSCF	Carbon Monoxide	N		15.5	LB/H	460.98	T/YR
							Nitrogen Oxides (NOx)	N		3.1	LB/H	92.21	T/YR
							Particulate Matter < 10 ? (PM10)	N		0.49	LB/H	14.16	T/YR

APPENDIX C

MACT Requirements

§ 60.4200 Am I subject to this subpart?

(2) Owners and operators of stationary CI ICE that commence construction after July 11, 2005 where the stationary CI ICE are:

(i) Manufactured after April 1, 2006 and are not fire pump engines, or

(ii) Manufactured as a certified National Fire Protection Association (NFPA) fire pump engine after July 1, 2006.

(3) Owners and operators of stationary CI ICE that modify or reconstruct their stationary CI ICE after July 11, 2005.

§ 60.4205 What emission standards must I meet for emergency engines if I am an owner or operator of a stationary CI internal combustion engine?

(a) Owners and operators of pre-2007 model year emergency stationary CI ICE with a displacement of less than 10 liters per cylinder that are not fire pump engines must comply with the emission standards in table 1 to this subpart. Owners and operators of pre-2007 model year non-emergency stationary CI ICE with a displacement of greater than or equal to 10 liters per cylinder and less than 30 liters per cylinder that are not fire pump engines must comply with the emission standards in 40 CFR 94.8(a)(1).

Model year means either:

(1) The calendar year in which the engine was originally produced, or

(2) The annual new model production period of the engine manufacturer if it is different than the calendar year. This must include January 1 of the calendar year for which the model year is named. It may not begin before January 2 of the previous calendar year and it must end by December 31 of the named calendar year. For an engine that is converted to a stationary engine after being placed into service as a nonroad or other non-stationary engine, model year means the calendar year or new model production period in which the engine was originally produced.

Table 1 to Subpart IIII of Part 60—Emission Standards for Stationary Pre-2007 Model Year Engines With a Displacement of <10 Liters per Cylinder and 2007–2010 Model Year Engines >2,237 KW (3,000 HP) and With a Displacement of <10 Liters per Cylinder

[As stated in §§60.4201(b), 60.4202(b), 60.4204(a), and 60.4205(a), you must comply with the following emission standards]

Maximum engine power	Emission standards for stationary pre-2007 model year engines with a displacement of <10 liters per cylinder and 2007–2010 model year engines >2,237 KW (3,000 HP) and with a displacement of <10 liters per cylinder in g/KW-hr (g/HP-hr)				
	NMHC + NO_X	HC	NO_X	CO	PM
KW<8 (HP<11)	10.5 (7.8)			8.0 (6.0)	1.0 (0.75)
8≤KW<19 (11≤HP<25)	9.5 (7.1)			6.6 (4.9)	0.80 (0.60)
19≤KW<37 (25≤HP<50)	9.5 (7.1)			5.5 (4.1)	0.80 (0.60)
37≤KW<56 (50≤HP<75)			9.2 (6.9)		
56≤KW<75 (75≤HP<100)			9.2 (6.9)		
75≤KW<130 (100≤HP<175)			9.2 (6.9)		
130≤KW<225 (175≤HP<300)		1.3 (1.0)	9.2 (6.9)	11.4 (8.5)	0.54 (0.40)
225≤KW<450 (300≤HP<600)		1.3 (1.0)	9.2 (6.9)	11.4 (8.5)	0.54 (0.40)
450≤KW≤560 (600≤HP≤750)		1.3 (1.0)	9.2 (6.9)	11.4 (8.5)	0.54 (0.40)
KW>560 (HP>750)		1.3 (1.0)	9.2 (6.9)	11.4 (8.5)	0.54 (0.

APPENDIX D

Calculations

Bio Energy, Washington, LLC

Table D-1
Summary of Engine Emissions

No. Engines	Gas Fraction	Estimated CO Reduction	Estimated CH2O reduction	Estimated PM reduction	estimated NOx Reduction	MMBtu/hr	NOx lb/hr	CO lb/hr	SO2 lb/hr	VOC lb/hr	CH2O lbs/hr	PM lb/hr	NOx TPY	CO TPY	SO2 TPY	VOC TPY	CH2O TPY	PM TPY
10	92%	0%	0%	0%	0%	31.5	11.40	51.85	0.00	6.88	3.21	0.54	49.95	227.10	0.02	30.12	14.04	2.35
10	92%	97%	97%	35%	0%	31.5	11.40	1.56	0.00	0.69	0.10	0.35	49.95	6.81	0.02	3.01	0.42	1.52
10	92%	90%	90%	35%	75%	31.5	2.85	5.18	0.00	0.69	0.32	0.35	12.49	22.71	0.02	3.01	1.40	1.52

	0.36	lb/mmBtu	453.6	g/lb	36.8	MMbtu/hr /	350	kw	1.696547	g NOx/kw-hr	
	1.64	lb/mmBtu	453.6	g/lb	36.8	MMbtu/hr /	350	kw	7.826233	g CO/kw-hr	No Cat
	1.56	lb/hr	453.6	g/lb	350.0	kw-hr			0.201589	g CO/kw-hr	w/Cat
	0.62	lb/hr	453.6	g/lb	350.0	kw-hr			0.080968	g PM/kw-hr	
	8.02	lb/hr	453.6	g/lb	350.0	kw-hr			1.039929	g VOC/kw-hr	
0%	1.43	lb/mmBtu	453.6	g/lb	39.9	MMbtu/hr /	350	kw	7.387348	g NOx/kw-hr	
12 engines											

Option All engines at 0% gas fraction, 500 hours and 10 engines at 92% gas fraction 8260 hours

No. Engines	Gas Fraction	Estimated CO Reduction	Estimated CH2O reduction	Estimated PM reduction	Estimated VOC reduction	estimated NOx Reduction	MMBtu/hr	NOx lb/hr	CO lb/hr	SO2 lb/hr	VOC lb/hr	CH2O lbs/hr	PM lb/hr	NOx TPY	CO TPY	SO2 TPY	VOC TPY	CH2O TPY	PM TPY
12	0%	97%	97%	35%	90%	0%	39.9	57.46	0.50	0.06	0.20	0.00	0.44	14.36	0.13	0.02	0.05	0.00	0.11
10	92%	97%	97%	35%	90%	0%	31.5	11.40	1.56	0.00	0.69	0.10	0.35	47.10	6.42	0.02	2.84	0.40	1.44
Total Annual														**61.46**	**6.55**	**0.03**	**2.89**	**0.40**	**1.55**

Table D-2. Hourly Emissions Rates with no controls

Gas Fraction	NOx lb/mmbtu	CO lb/mmbtu	No Engines Single Fuel	NO Engines Dual Fuel	MMBtu/hr single Fuel	MMBtu/hr Dual Fuel	Fuel Oil gal/hr	LFG CFH	NOx lb/hr	CO lb/hr	SO2 lb/hr	VOC lb/hr	CH2O lbs/hr	PM lb/hr
81%	0.38	1.6537	0	10	0.0	23.1	32	36960	8.73	38.20	0.01	5.04	2.35	0.39
82%	0.38	1.653	0	10	0.0	24.2	32	39117	9.09	39.92	0.01	5.27	2.46	0.41
83%	0.38	1.6523	0	10	0.0	25.2	31	41315	9.45	41.64	0.01	5.50	2.56	0.43
84%	0.37	1.6516	0	10	0.0	26.3	31	43555	9.81	43.35	0.01	5.73	2.67	0.45
85%	0.37	1.6509	0	10	0.0	27.3	30	45837	10.16	45.07	0.01	5.96	2.78	0.46
86%	0.37	1.6502	0	10	0.0	27.3	28	46376	10.12	45.05	0.01	5.96	2.78	0.46
87%	0.37	1.6495	0	10	0.0	27.8	26	47818	10.28	45.90	0.01	6.08	2.83	0.47
88%	0.37	1.6488	0	10	0.0	28.4	25	49280	10.43	46.74	0.01	6.19	2.89	0.48
89%	0.37	1.6481	0	10	0.0	28.4	23	49840	10.39	46.72	0.00	6.19	2.89	0.48
90%	0.36	1.6474	0	10	0.0	31.5	23	56000	11.49	51.89	0.00	6.88	3.21	0.54
91%	0.36	1.6467	0	10	0.0	31.5	21	56622	11.45	51.87	0.00	6.88	3.21	0.54
92%	0.36	1.646	0	10	0.0	31.5	18	57244	11.40	51.85	0.00	6.88	3.21	0.54
93%	0.36	1.6453	0	10	0.0	33.6	17	61724	12.11	55.28	0.00	7.34	3.42	0.57
94%	0.36	1.6446	0	10	0.0	34.7	15	64338	12.44	56.99	0.00	7.57	3.53	0.59
95%	0.36	1.6439	0	10	0.0	35.7	13	66992	12.77	58.69	0.00	7.79	3.63	0.61
96%	0.36	1.6432	0	10	0.0	36.8	11	69689	13.09	60.39	0.00	8.02	3.74	0.62

Table D-3. Hourly Emissions Rates with Controls

Gas Fraction	NOx lb/mmbtu	CO lb/mmbtu	No Engines Single Fuel	NO Engines Dual Fuel	MMBtu/hr single Fuel	MMBtu/hr Dual Fuel	Fuel Oil gal/hr	LFG CFH	NOx lb/hr	CO lb/hr	SO2 lb/hr	VOC lb/hr	CH2O lbs/hr	PM lb/hr
81%	0.38	0.049611	0	10	0.0	23.1	32	36960	8.73	1.15	0.01	0.50	0.07	0.26
82%	0.38	0.04959	0	10	0.0	24.2	32	39117	9.09	1.20	0.01	0.53	0.07	0.27
83%	0.38	0.049569	0	10	0.0	25.2	31	41315	9.45	1.25	0.01	0.55	0.08	0.28
84%	0.37	0.049548	0	10	0.0	26.3	31	43555	9.81	1.30	0.01	0.57	0.08	0.29
85%	0.37	0.049527	0	10	0.0	27.3	30	45837	10.16	1.35	0.01	0.60	0.08	0.30
86%	0.37	0.049506	0	10	0.0	27.3	28	46376	10.12	1.35	0.01	0.60	0.08	0.30
87%	0.37	0.049485	0	10	0.0	27.8	26	47818	10.28	1.38	0.01	0.61	0.08	0.31
88%	0.37	0.049464	0	10	0.0	28.4	25	49280	10.43	1.40	0.01	0.62	0.09	0.31
89%	0.37	0.049443	0	10	0.0	28.4	23	49840	10.39	1.40	0.00	0.62	0.09	0.31
90%	0.36	0.049422	0	10	0.0	31.5	23	56000	11.49	1.56	0.00	0.69	0.10	0.35
91%	0.36	0.049401	0	10	0.0	31.5	21	56622	11.45	1.56	0.00	0.69	0.10	0.35
92%	0.36	0.04938	0	10	0.0	31.5	18	57244	11.40	1.56	0.00	0.69	0.10	0.35
93%	0.36	0.049359	0	10	0.0	33.6	17	61724	12.11	1.66	0.00	0.73	0.10	0.37
94%	0.36	0.049338	0	10	0.0	34.7	15	64338	12.44	1.71	0.00	0.76	0.11	0.38
95%	0.36	0.049317	0	10	0.0	35.7	13	66992	12.77	1.76	0.00	0.78	0.11	0.39
96%	0.36	0.049296	0	10	0.0	36.8	11	69689	13.09	1.81	0.00	0.80	0.11	0.41

Bio Energy (Washington), LLC

Figure D-4
Summary of Criteria Emissions from Thermal Oxidizer

Compound	lbs/MMBtu	lbs/106 dscf CH4	tons/year	pounds/year	pounds/hr
Nitrogen Dioxide	0.06		10.3	20532	2.3
Carbon Monoxide	0.30		51.3	102661	11.7
Particulate Matter		17	2.9	5861	0.669
NMOC			11.0	21996	3
SO2			0.1	120	0.01

Thermal Oxidixer Flow

Source	scfm inlet	methane scfm	MMBtu/hr	dscf/10^6 Btu	dscf/hr	methane only dscf/min	total flow dscf/min	%H2O	%O2	Temp	acf/min
Landfill gas	5450	616.4	36.7	8710	319760.39	5329.34	10162.94				
Assist gas	85.1	39.5	2.4	8710	20490.98	341.52	387.12				
Total	5535.1	655.9	39.1			5670.86	10550.06	0.10	12	1700	111486.9

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Table D-5
Thermal Oxidizer TAP Emissions

Landfill gas flowrate (acf/min) =	11000
Gas temperature (oF) =	110
Gas pressure (inches Hg) =	30.5
Gas moisture content (%)	1.5
Landfill gas flowrate (dscf/min) =	9846
Landfill gas flowrate (dscm/min) =	279
Thermal oxidizer destruction efficiency	98%

Estimated Maximum VOC Content

CAS NO.	Compound Name		MW	Maximum Concentration	Flare Inlet	Flare Outlet	Emission Rate	Emission Rate
		(ppmv)	g/mole	mg/m3	mg/min	mg/min	lb/year	lb/hr
75-34-3	1,1-Dichloroethane	0.5	98.96	2	574	11	13.3	1.52E-03
95-63-6	1,2,4-trimethylbenzene	3.5	120.2	17	4,879	98	113.1	1.29E-02
107-06-2	1,2-dichloroethane	0.1	99.0	0	115	2	2.7	3.04E-04
108-67-8	1,3,5-trimethylbenzene	3.5	113.0	16	4,587	92	106.3	1.21E-02
78-93-3	2-Butanone	21.5	72.1	64	17,983	360	416.7	4.76E-02
108-10-1	4-Methyl-2-pentanone (MIBK)	2	100.2	8	2,323	46	53.8	6.15E-03
67-64-1	Acetone	31.4	58.1	76	21,153	423	490.2	5.60E-02
71-43-2	Benzene	2.4	78.1	8	2,174	43	50.4	5.75E-03
67-66-3	Chloroform	0.7	119.4	3	969	19	22.5	2.56E-03
74-87-3	Chloromethane	2.4	50.5	5	1,406	28	32.6	3.72E-03
156-59-2	cis-1,2-dichloroethene	1.1	96.9	4	1,237	25	28.7	3.27E-03
110-82-7	Cyclohexane	3.9	84.2	14	3,808	76	88.2	1.01E-02
75-71-8	Dichlorodifluoromethane (Freon 12)	2.4	120.9	12	3,366	67	78.0	8.91E-03
64-17-5	Ethanol	5.9	46.1	11	3,152	63	73.1	8.34E-03
141-78-6	Ethyl Acetate	1.4	88.1	5	1,431	29	33.2	3.78E-03
100-41-4	Ethylbenzene	12.7	106.2	56	15,638	313	362.4	4.14E-02
142-82-5	Heptane	3.7	116.2	18	4,985	100	115.5	1.32E-02
100-54-3	Hexane	10.7	86.2	38	10,696	214	247.9	2.83E-02
67-63-0	Isopropyl alcohol	24.8	60.1	62	17,285	346	400.6	4.57E-02
1330-20-7	m/p-Xylene	26.5	106.2	117	32,637	653	756.3	8.63E-02
1634-04-4	Methyl-t-butyl ether (MTBE)	0.02	88.2	0	20	0	0.5	5.41E-05
95-47-6	o-Xylene	6.5	106.2	29	8,007	160	185.6	2.12E-02
100-42-5	Styrene	0.9	32.9	1	343	7	8.0	9.09E-04

Bio Energy (Washington), LLC

Table D-5
Thermal Oxidizer TAP Emissions

127-18-4	Tetrachloroethylene	0.7	266.4	8	2,163	43	50.1	5.72E-03
109-99-9	Tetrahydrofuran	7	72.1	21	5,855	117	135.7	1.55E-02
108-88-3	Toluene	30.4	92.1	117	32,486	650	752.8	8.59E-02
75-25-2	Tribromomethane	0.8	252.8	8	2,346	47	54.4	6.21E-03
79-01-6	Trichloroethylene	0.8	167.9	6	1,558	31	36.1	4.12E-03
75-69-4	Trichloromonofluoromethane	0.6	137.7	3	958	19	22.2	2.54E-03
108-05-4	Vinyl acetate	5.6	86.1	20	5,592	112	129.6	1.48E-02
10102-43-9	Nitric oxide						18,479.0	2.11E+00
	Total						23,339.3	
							11.67	Tons
	Total without Nitric oxide						4860.28	
							2.43	tons

Criteria Pollutants

NMOC as hexane	951.5	86	3,404	949,128	18,983	21,996	3
Sulfur dioxide	7	64	19	5196	104	120	0

Bio Energy (Washington), LLC

Figure D-6
Electrical Generating Faciltiy Tap Emissions

Duel fuel heat input at 92% landfill gas = 31.5 MMBtu/hr

Compound	lbs/MMBtu	pounds/year	pounds/hr	% control	pounds/year	pounds/hr
1,4 Dichlorobenzene	1.91E-05	5.28	6.03E-04	90%	0.53	6.03E-05
1-Methylnaphthalene	2.622E-05	7.24	8.26E-04	90%	0.72	8.26E-05
2-Methylnaphthalene	6.870E-05	18.96	2.16E-03	90%	1.90	2.16E-04
Acetaldehyde	1.700E-03	469.10	5.36E-02	90%	46.91	5.36E-03
Benzene	6.076E-04	167.67	1.91E-02	90%	16.77	1.91E-03
Chloroethene (Vinyl Chloride)	2.152E-05	5.94	6.78E-04	90%	0.59	6.78E-05
Chloromethane	9.13E-06	2.52	2.88E-04	90%	0.25	2.88E-05
Formaldehyde	1.02E-01	28082.43	3.21E+00	97%	842.47	9.62E-02
Hydrogen Chloride	7.000E-04	193.16	2.21E-02	0%	193.16	2.21E-02
Methylene Chloride	1.46E-05	4.04	4.61E-04	90%	0.40	4.61E-05
Naphthalene	5.101E-05	14.07	1.61E-03	90%	1.41	1.61E-04
Naphthalene - Total		4.03E+01	4.60E-03	90%	4.03	4.60E-04
Phenanthrene	1.043E-04	28.77	3.28E-03	90%	2.88	3.28E-04
Nitrogen oxide	0.32	89404.56	1.02E+01	0%	89404.56	1.02E+01

262.90 Non CH2O HAP
1105.37 Total HAP
0.55 Tons HAPs

Bio Energy (Washington), LLC

Figure D-7
Summary of TAPs and Modeling Impacts

	Generator Emissions		Flare Emissions		Total Emissions		TAP	ASIL	SQER	SQER	Modeling Required
Compound	pounds/year	pounds/hr	pounds/year	pounds/hr	pounds/year	pounds/hr		(ug/m3)	(lb/year)	(lb/hr)	
1,1-Dichloroethane			13.30	1.52E-03	1.33E+01	1.52E-03	B	2,700	43,748	5.0	N
1,2,4-trimethylbenzene			113.07	1.29E-02	1.13E+02	1.29E-02	B	420	43,748	5.0	N
1,2-dichloroethane			2.66	3.04E-04	2.66E+00	3.04E-04	A	0	10		N
1,3,5-trimethylbenzene			106.30	1.21E-02	1.06E+02	1.21E-02	B	420	43,748	5.0	N
1,4 Dichlorobenzene	0.53	6.03E-05			5.28E-01	6.03E-05	A	2	500		N
2-Butanone			416.74	4.76E-02	4.17E+02	4.76E-02	B	1,000	43,748	5.0	N
4-Methyl-2-pentanone (MIBK)			53.85	6.15E-03	5.38E+01	6.15E-03	B	680	43,748	5.0	N
1-Methylnaphthalene	0.72	8.26E-05			7.24E-01	8.26E-05	B	170	22,750	2.6	N
2-Methylnaphthalene	1.90	2.16E-04			1.90E+00	2.16E-04	B	170	22,750	2.6	N
Acetaldehyde	46.91	5.36E-03			4.69E+01	5.36E-03	A	0.450	50		N
Acetone			490.21	5.60E-02	4.90E+02	5.60E-02	B	5,900	43,748	5.0	N
Benzene	16.77	1.91E-03	50.38	5.75E-03	6.72E+01	7.67E-03	A	0.120	20		Y
Chloroethene (Vinyl Chloride)	0.59	6.78E-05			5.94E-01	6.78E-05	A	0.012	10		N
Chloroform			22.46	2.56E-03	2.25E+01	2.56E-03	A	0.043	10		Y
Chloromethane	0.25	2.88E-05	32.57	3.72E-03	3.28E+01	3.75E-03	B	340	43,748	5.0	N
cis-1,2-dichloroethene			28.66	3.27E-03	2.87E+01	3.27E-03	B	2,600	43,748	5.0	N
Cyclohexane			88.25	1.01E-02	8.82E+01	1.01E-02	B	3,400	43,748	5.0	N
Dichlorodifluoromethane (Freon 12)			78.01	8.91E-03	7.80E+01	8.91E-03	B	16,000	43,748	5.0	N
Ethanol			73.05	8.34E-03	7.31E+01	8.34E-03	B	6,300	43,748	5.0	N
Ethyl Acetate			33.15	3.78E-03	3.32E+01	3.78E-03	B	4,800	43,748	5.0	N
Ethylbenzene			362.41	4.14E-02	3.62E+02	4.14E-02	B	1,000	43,748	5.0	N
Formaldehyde	842.47	9.62E-02			8.42E+02	9.62E-02	A	0.077	20		Y
Hydrogen Chloride	193.16	2.21E-02			1.93E+02	2.21E-02	B	7	175	0.02	Y
Heptane			115.53	1.32E-02	1.16E+02	1.32E-02	B	5,500	43,748	5.0	N
Hexane			247.87	2.83E-02	2.48E+02	2.83E-02	B	200	22,750	2.6	N
Isopropyl alcohol			400.57	4.57E-02	4.01E+02	4.57E-02	B	3,300	43,748	5.0	N
m/p-Xylene			756.34	8.63E-02	7.56E+02	8.63E-02	B	1,500	43,748	5.0	N
Methyl-t-butyl ether (MTBE)			0.47	5.41E-05	4.74E-01	5.41E-05	B	500	43,748	5.0	N
Methylene Chloride	0.40	4.61E-05			4.04E-01	4.61E-05	A	0.560	50		N
Naphthalene	1.41	1.61E-04			1.41E+00	1.61E-04	B	170	22,750	2.6	N
Naphthalene - Total	4.03	4.60E-04			4.03E+00	4.60E-04	B	170	22,750	2.6	N
o-Xylene			185.55	2.12E-02	1.86E+02	2.12E-02	B	1,500	43,748	5.0	N
Phenanthrene	2.88	3.28E-04			2.88E+00	3.28E-04	PAH	0.00048	none		Y
Styrene			7.96	9.09E-04	7.96E+00	9.09E-04	B	1,000	43,748	5.0	N

Bio Energy (Washington), LLC

Figure D-7
Summary of TAPs and Modeling Impacts

	Generator Emissions		Flare Emissions		Total Emissions		TAP	ASIL	SQER	SQER	Modeling Required
Compound	pounds/year	pounds/hr	pounds/year	pounds/hr	pounds/year	pounds/hr		(ug/m3)	(lb/year)	(lb/hr)	
Tetrachloroethylene			50.12	5.72E-03	5.01E+01	5.72E-03	A	1.100	500		N
Tetrahydrofuran			135.68	1.55E-02	1.36E+02	1.55E-02	B	2,000	43,748	5.0	N
Toluene			752.84	8.59E-02	7.53E+02	8.59E-02	B	400	43,748	5.0	N
Tribromomethane			54.36	6.21E-03	5.44E+01	6.21E-03	A	0.910	50		N
Trichloroethylene			36.09	4.12E-03	3.61E+01	4.12E-03	A	0.059	50		N
Trichloromonofluoromethane			22.21	2.54E-03	2.22E+01	2.54E-03	B	19,000	43,748	5.0	N
Vinyl acetate			129.59	1.48E-02	1.30E+02	1.48E-02	B	200	22,750	2.6	N
Nitric Oxide	89404.56	1.02E+01	20532	2.1	1.10E+05	1.23E+01	B	100	17,500	2.0	Y